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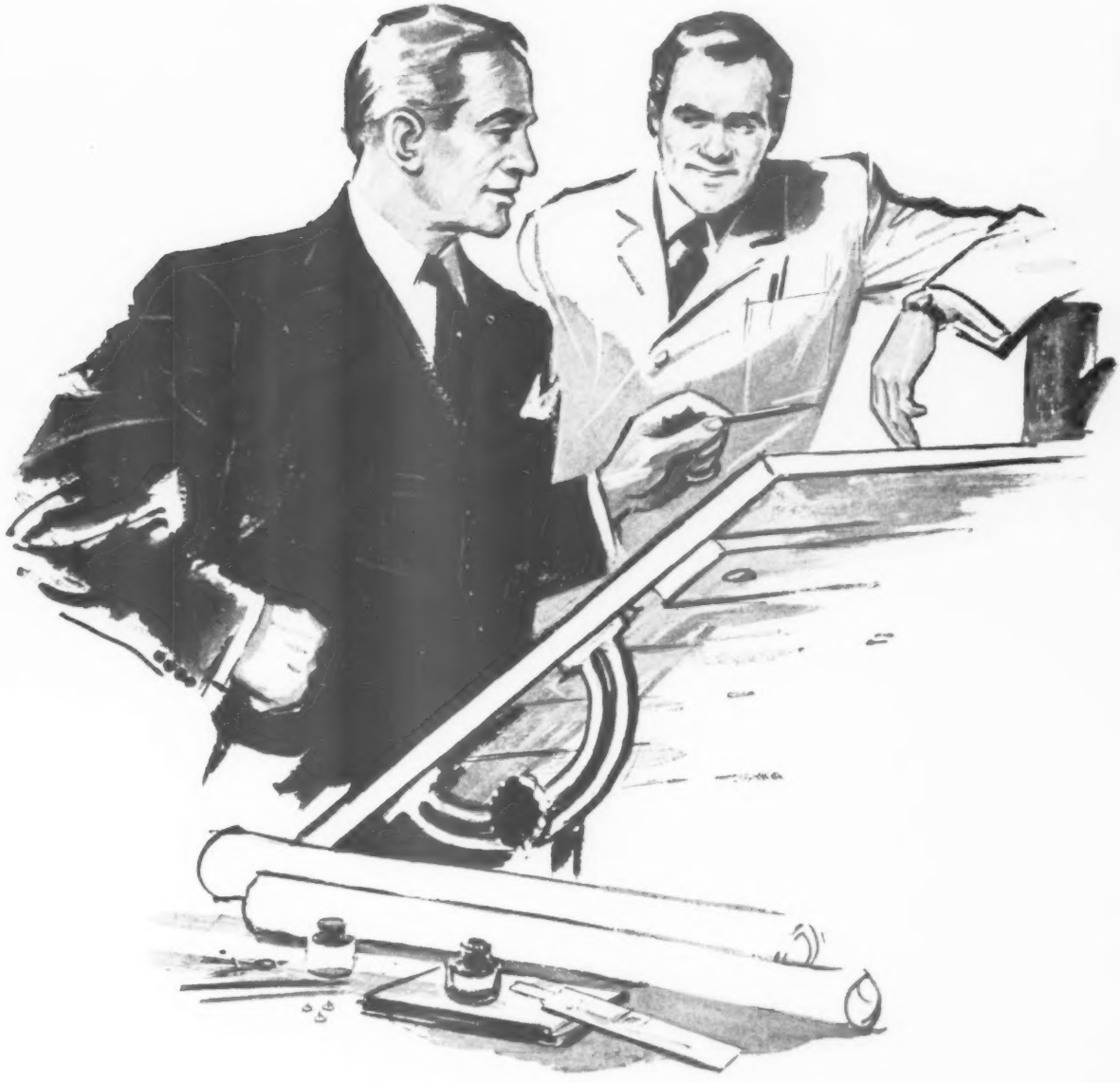

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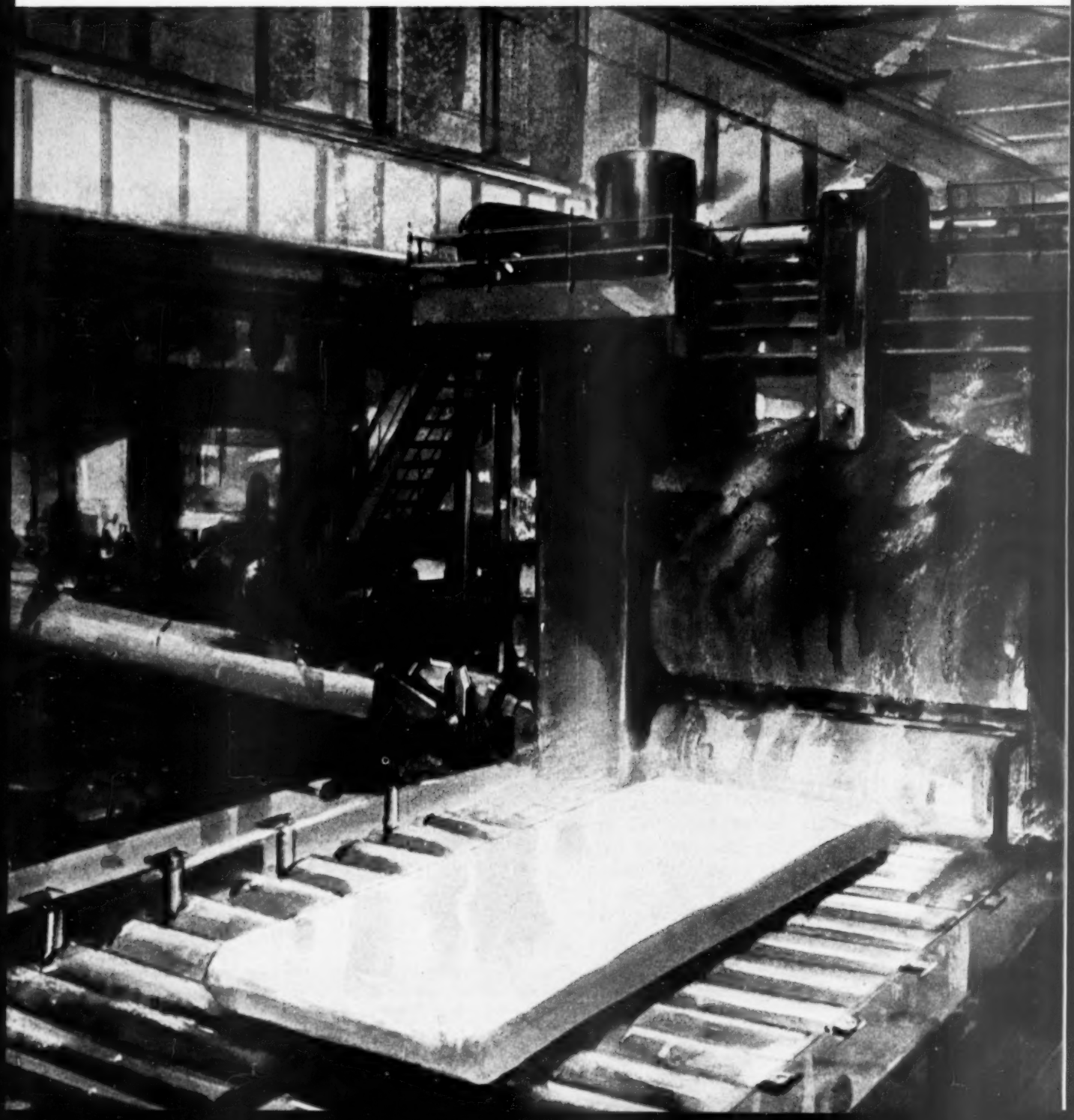
A

Simplicate and add more lightness



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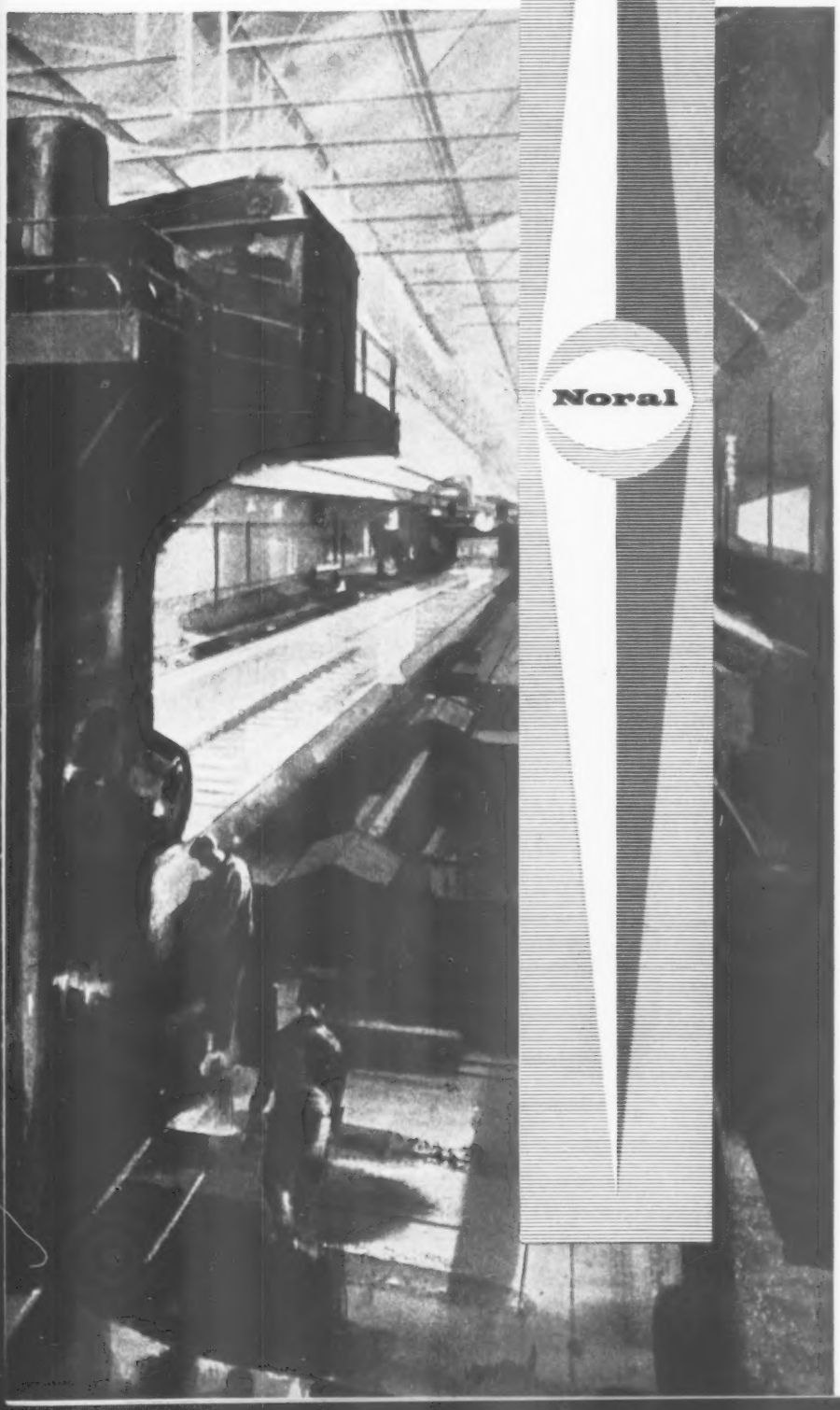

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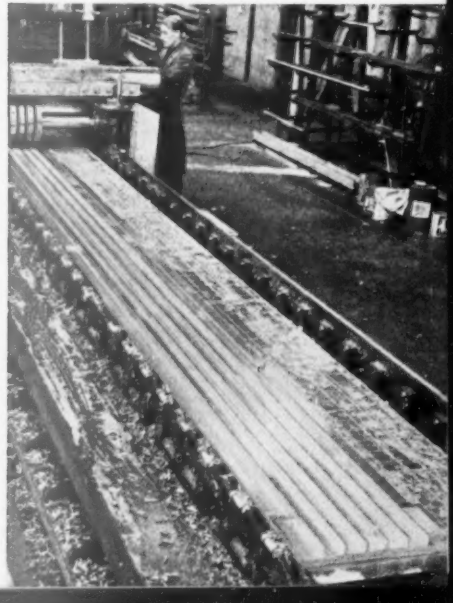
BELOW *One of the wing-skin panels for the Vanguard being machined from Noral B26S plate 2 in. thick.*

(By courtesy of Vickers-Armstrongs Ltd.)



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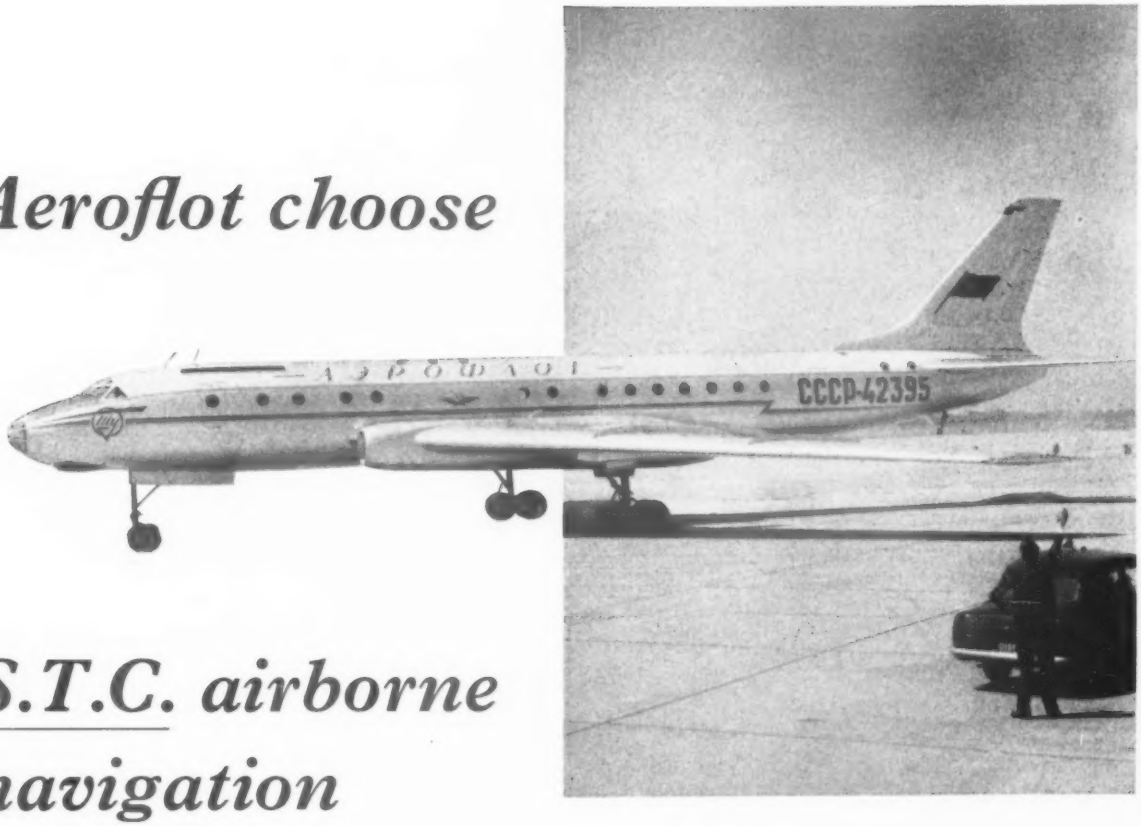

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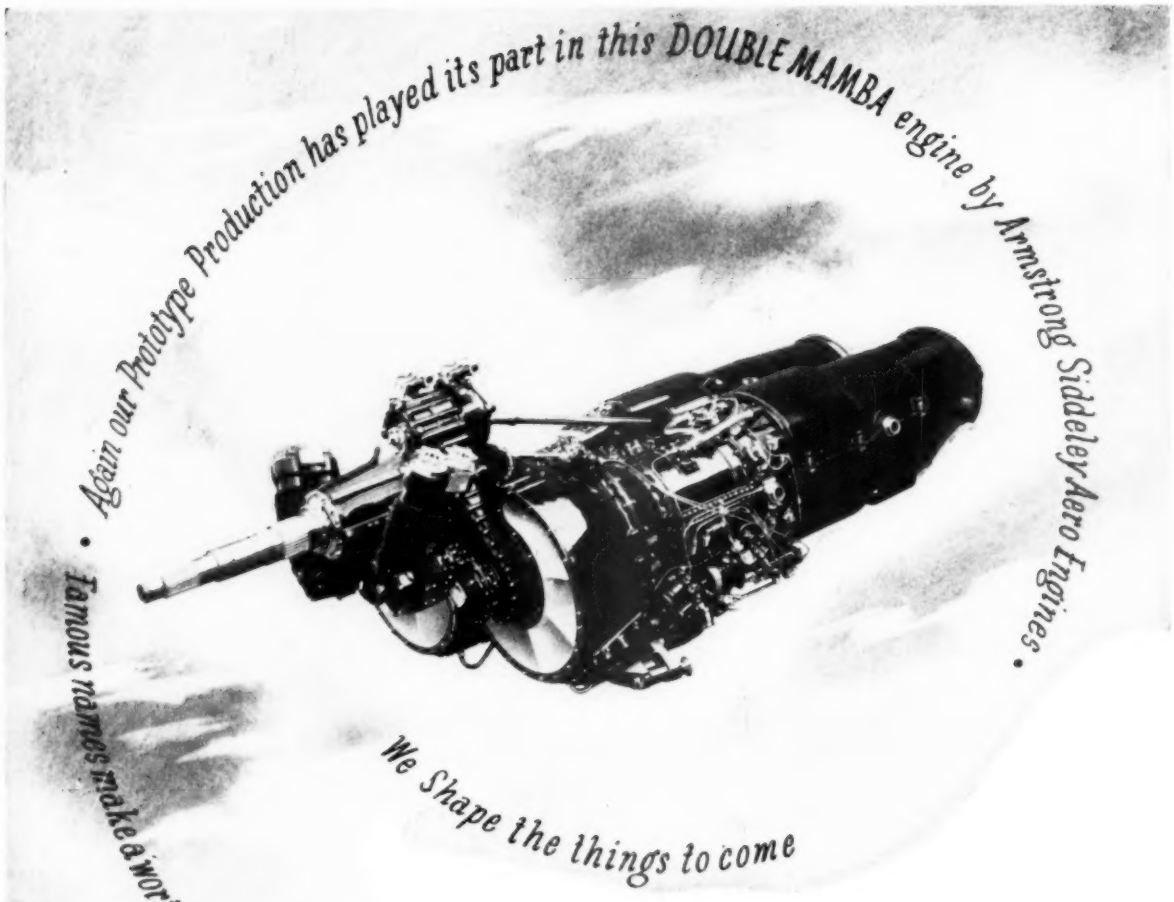
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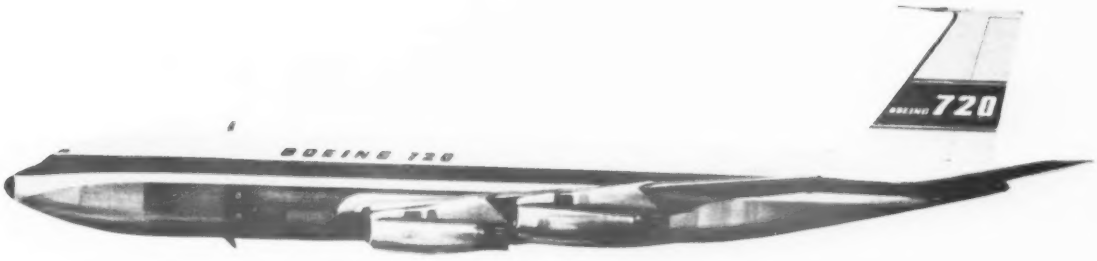
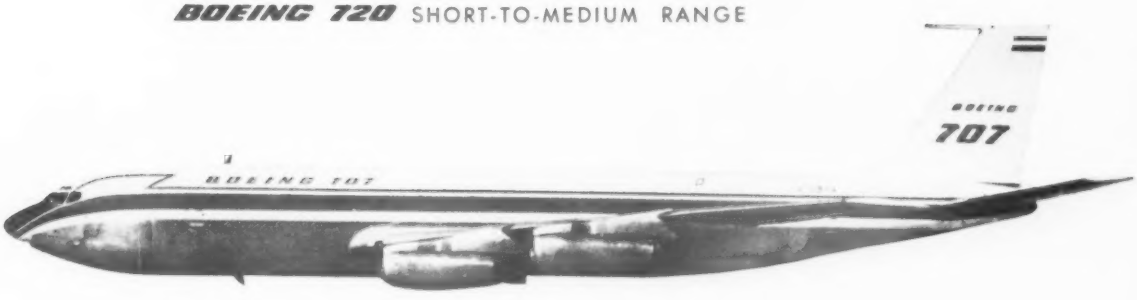
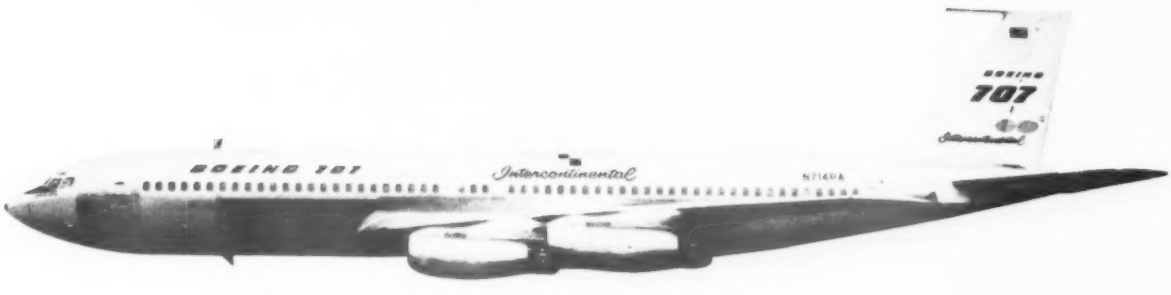


BOEING 720 SHORT-TO-MEDIUM RANGE



BOEING 707 MEDIUM-LONG RANGE



BOEING 707 *Intercontinental* VERY LONG RANGE

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The Boeing jetliners shown above are designed for profitable operations over all airline routes, from short intercity segments to very long overocean stages.

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A VERY HAPPY CHRISTMAS
AND PROSPERITY
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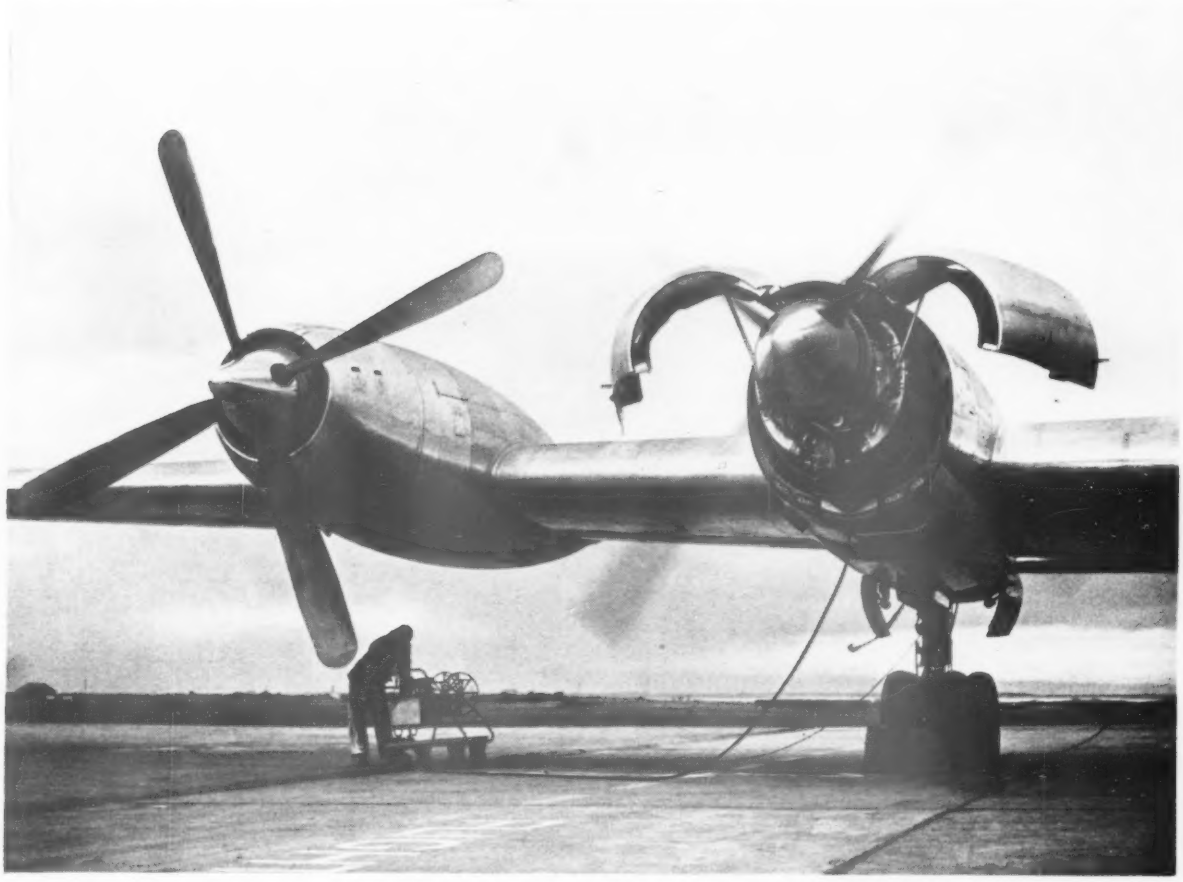

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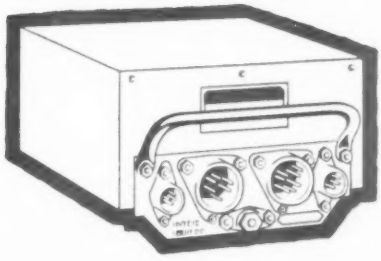

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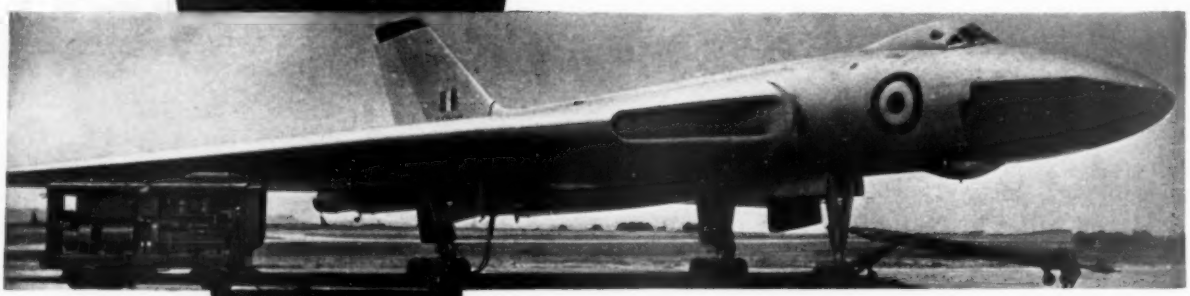

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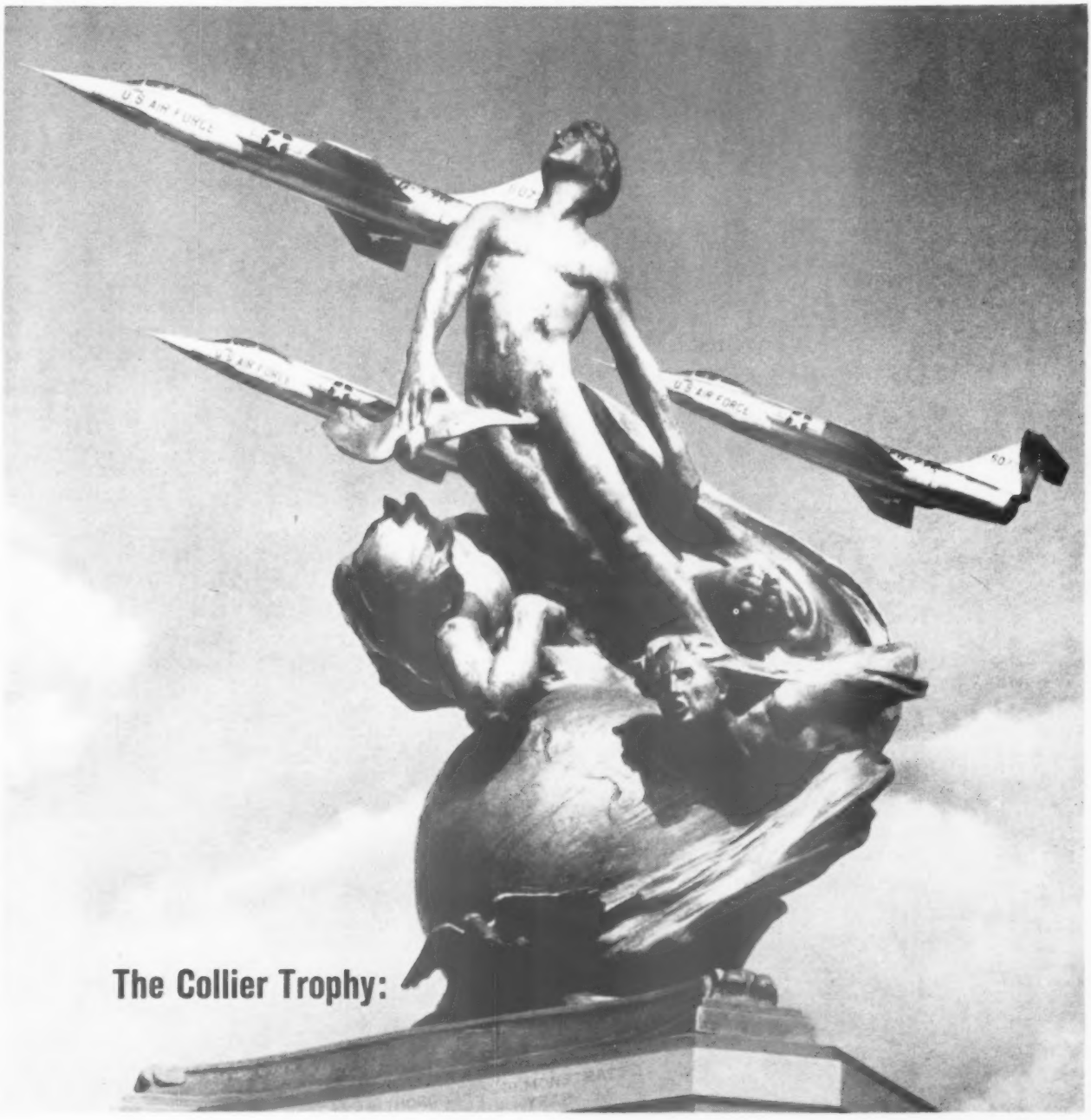

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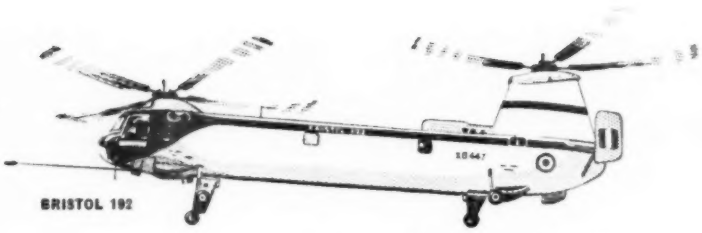
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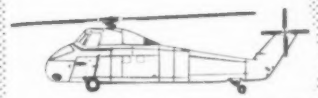

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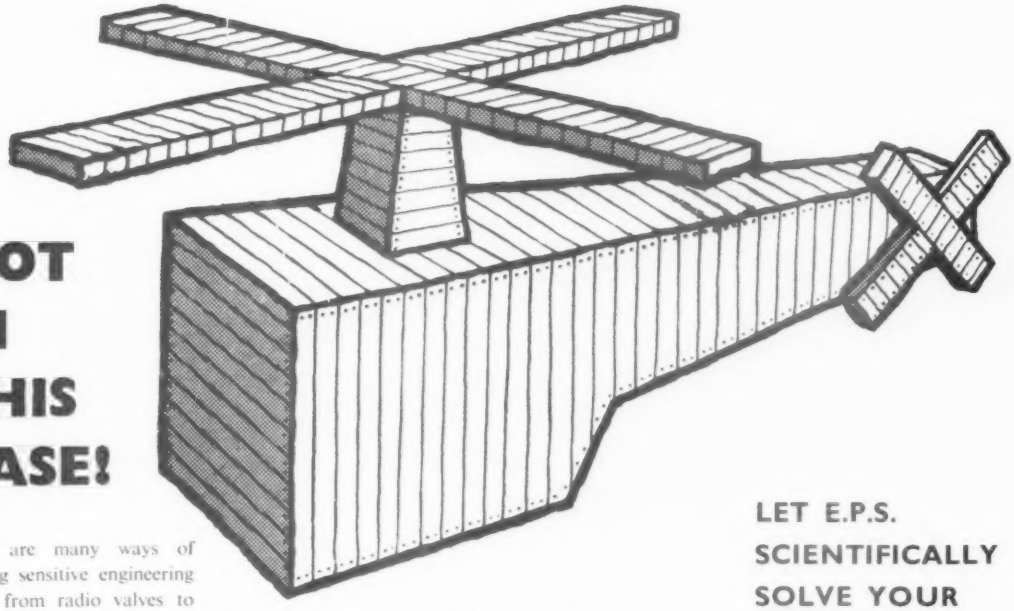

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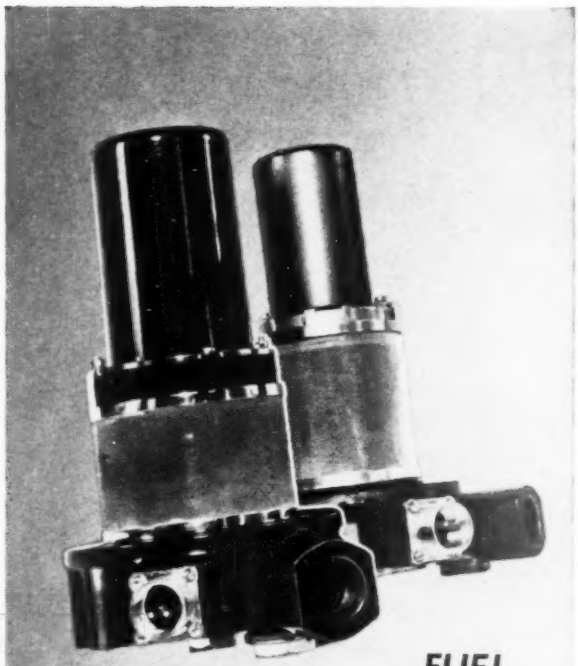

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ALL HELICOPTERS of British design flying to-day are fitted with FUEL BOOSTER PUMPS designed and manufactured by SPE.

Illustrated are two of these pumps—the B.P.5 Mk.5 with a rating of 100 g.p.h. at 9.0 lb./sq. in. minimum delivery pressure and the smaller B.P.14 Mk.3 rated at 50 g.p.h. with a minimum delivery pressure of 5 lb./sq. in.

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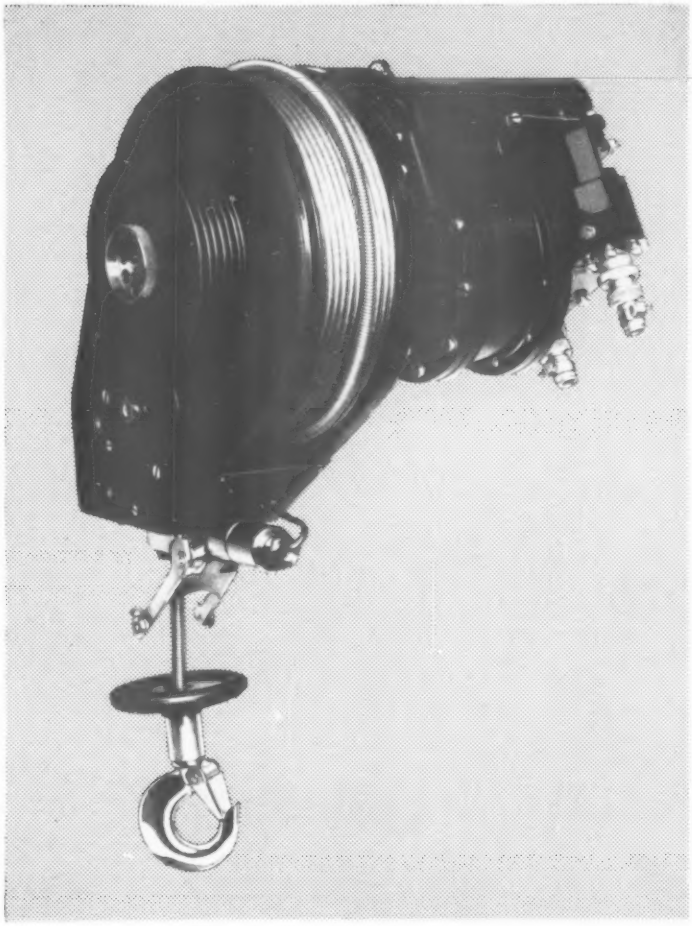

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SAFE IN ALL EMERGENCIES Auto stopping at upper and lower limits. Remote control cable cutter. Load pressure prevents high speed running and swaying hook. Hot air circulation prevents icing up.

SPECIFICATION

Maximum load	440 lb. (31½ stone)
Hoisting speed	21 in/sec. (for 220 lb.)
Air pressure required	40 p.s.i.
Maximum air flow	0.066 lb./sec.
Maximum air temperature	200° C.
Solenoid valves electrical supply and consumption	24 volt, 4 amp.
Vertical hook travel	85 ft.
Total weight (including cable, hook and accessories)	24½ lb.
Cable diameter	3/16 in.
Cable brake load	2,200 lb.

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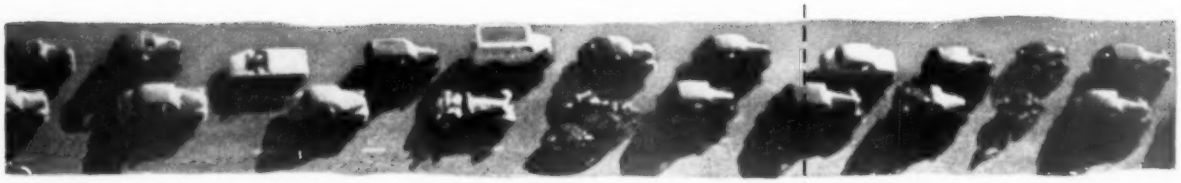
LUCAS

What a business it is getting from the middle of one city to the middle of another . . .



Never mind — look forward to

ROTODYNE TRAVEL

The first vertical take-off airliner in the world

FAIREY

THE AEROPLANE and ASTRONAUTICS

VOLUME 97 NUMBER 2512 DECEMBER 11, 1959

Cold Steel

There was a time when the only visible support for building a supersonic airliner in this country was to be found in the pages of THE AEROPLANE AND ASTRONAUTICS. Fortunately, those days are now behind us and at long last the Government have progressed to the stage when the chief problem remaining to be solved is not who shall build it—the chief problem concerns the speeds to be designed for, and, in consequence, the material of construction is still a matter for argument.

Thus it is with approval that we greet the first release of official material about the supersonic project which for so long has been taking shape in the hangars at Filton. The noteworthy aspect of this prototype is that it is entirely of steel. Its designers are aiming at speeds of up to Mach 3. If they had been content with speeds as low as those put forward later in the S.T.A.C. deliberations, then they could have been content to build with the more familiar light alloys. But, no doubt bearing in mind the fate of the piston-engined Brabazon, obsolescent before its trials, they felt that this time their prototype was going to be capable of considerable development.

The scale of effort to build a supersonic airliner is known to be vast. It will not only take time but it will take mass effort. In these days we are becoming used to national groupings to bring about worthwhile results. First steps to integrate Europe's air transport effort have been taken. By the time that supersonic airliners are flying, aircraft construction may have become grouped in Europe too. In such circumstances, namely, the growing integration of Western European industrial effort, the inauguration of flying trials with an all-steel M=2.5 prototype will be seen as an essential contribution to European activity in the supersonic field.

Noise—The Limit

Once again aircraft noise has occupied the attention of the House of Commons. This time from 3.18 p.m. until 4.16 p.m. on Nov. 27 last. The concluding words of the new Parliamentary Secretary to the Minister of Aviation were uncompromising:

> "In the last resort the sanction is not to allow the aircraft to fly. In that regard I can only say that we accept that there is a limit noise which the public cannot be expected to tolerate. That must be understood."

So far, as propulsive power per unit weight of engine has increased, the noise of the unit has tended to likewise. There are certain trends the other way, but these are not conclusive. It is true that propeller turbines are quieter than pure jets, and turbofans are expected to be quieter still, but nobody who lives around an airport today has any doubt that aircraft noise is getting worse. Incidentally, in our neck of the woods the Caravelle, so silent in its interior, is outstanding in announcing its passage overhead. It seems noisier from the ground in that particular location than do either the Boeing 707 or Tu-104.

Already those most in favour of the Fairey Rotodyne are perturbed about the noise the prototype makes during arrival and departure. The manufacturers of that VTOL airliner will have a very difficult problem to discover how the more powerful version now being designed can be made to make less noise. The same type of problem faces all trying to develop VTOL aircraft of various sorts

If aircraft noise is not going to be an intolerable nuisance, the rising generation of aircraft designers will have to react to existing problems of noise as a stimulus to fresh thinking. The public will not be happy about aircraft noise until it cannot be identified above all the other noises of civilization.

Editor - - - - - THURSTAN JAMES
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Matters of Moment

More Hawker Siddeley Expansion

YET another of the smaller units within the British aircraft industry is likely to be taken into the fold of a larger group. Last week came news of negotiations in hand which, subject to shareholders' approval, will result in the merger of the Blackburn Group with the Hawker Siddeley Group.

This take-over bid by Hawker Siddeley was announced on December 3. One Hawker Siddeley £1 ordinary share is being offered for each of the 2,750,436 Blackburn 10s. ordinary shares. At the stock market close on December 3 Hawker Siddeley shares were quoted at 30s. 9d. and Blackburn ones at 30s. 6d. In addition a tax-free capital dividend of 1s. per share will be paid to Blackburn shareholders out of profits from a recent property sale. The offer values the Blackburn Group at nearly £4.4 million.

In a statement circulated to Blackburn employees, Mr. Eric Turner, the company's chairman, said that the move had been taken solely to improve and safeguard the company's long-term prospects. All companies in the Blackburn Group would carry on as at present and there was no question of any of the existing work of any of the companies being transferred elsewhere. Membership of the Hawker Siddeley Group would put the company in a better position for the new types to follow current engine and aircraft contracts.

Anglo-German Missiles and Aero-engines

JOINT British and German development of an army missile, anti-tank missiles and aero-engines were discussed in Bonn last week by Mr. Watkinson and Herr Strauss, Defence Ministers of the two countries. According to Mr. Watkinson, it is also hoped that Germany will buy a British naval missile for close-range anti-aircraft defence; this is presumably the Short Seacat SAM.

The joint aero-engine development referred to is that by Rolls-Royce and Maschinenfabrik Augsburg-Nürnberg, which is reported to be developing a small supersonic turbojet based on the Rolls-Royce RB.153. No information about the RB.153 is available from Rolls-Royce, but it may be a derivative of the RB.145. This very light engine, mentioned as a supersonic military powerplant on the Rolls-Royce stand at Farnborough, has been developed from the RB.108 VTOL engine and has a thrust of 2,750 lb. The engine under development by M.A.N. will power a supersonic VTOL strike aircraft being designed by Messerschmitt.

The army missile that Britain and Germany are jointly to develop is Blue Water, the English Electric corps-support missile; its adoption by NATO is being recommended. First information about this missile was given in September by English Electric. Designed to replace the Corporal SSM, it is believed to be a relatively small solid-fuel missile with a range approaching 100 miles. It will carry a nuclear warhead.

The agreement to collaborate in developing guided anti-tank missiles under German leadership has tended to confuse the position so far as the British Army is concerned. Fairey Aviation developed a missile for the Army, but this was cancelled following changes in requirements and the company is now believed to be working on another anti-tank missile. Meanwhile the Army has ordered the Malkara anti-tank missile from Australia; now apparently it may take up yet another to be developed mainly by Germany.

Anglo-German collaboration, particularly on the missile side, may well help the sales of British missiles considerably. Apart from Bloodhound, which has been adopted by Sweden and Australia, overseas missile sales have been disappointing. NATO adoption of Britain's missiles would be very welcome.

F-104 Starfighter Withdrawal

AN American report has stated that the U.S.A.F. Air Defense Command is to withdraw its 150-odd Lockheed F-104A and F-104B Starfighters from operational service early in the New Year. The main reasons for this move are said to be the interceptor's lack of all-weather capability, its inability to operate within the SAGE network and its relatively short range for North American operations.

This decision will not affect the F-104C and F-104D fighter-bombers in service with the U.S.A.F. Tactical Air Command and no official announcement has been made on the future of the earlier marks. It is thought, however, that they will be offered to the American foreign military aid programme.

During the past few weeks there have been a number of F-104 accidents, mostly involving the interceptor marks. There have been three reported power failures on take-off, an engine flame-out at altitude and a systems malfunction causing an asymmetric flap condition.

Soviet Air Strength

COMPARATIVE figures for the Russian and U.S. strategic bombing forces are given in the latest pamphlet, published by the Institute of Strategic Studies, on "The Soviet Union and the NATO Powers—the Military Balance." These figures are unofficial, but are compiled from authoritative sources.

Total personnel strength of the Russian Air Force is quoted as 700,000. The strategic bombing force, or, Dalnaya Aviatsiya (Long-range Aviation) is said mainly to comprise 200 "Bear" (Tu-20) turboprop aircraft; 500 "Bison" (Myasishchev) heavy

BELFAST PRODUCTION.—Canberra PR.9s on the production line at the Queen's Island works of Short Brothers and Harland, Ltd. This latest version of the Canberra has a hinged nose, designed by the company for access to the navigator's station, which has an ejector seat.

Photograph copyright "The Aeroplane and Astronautics"

MAJORITY CELEBRATIONS.—Among the guests at the House of Commons on Dec. 3 celebrating the 21st birthday of Derby Aviation, Ltd., was the Parliamentary Secretary of the new Ministry of Aviation, Mr. Geoffrey Rippon (third from right). Extreme left is the host and chairman of the company, Gp. Capt. C. A. B. Wilcock, M.P.; next to him is Lord Terrington and then Air Vice-Marshal Sir John Cordingley. Extreme right is Air Vice-Marshal Sir Conrad Collier and next to him Air Chief Marshal Sir Francis Fogarty.

jet bombers, with a similar 6,000-mile range; 500 "Badger" (Tu-16) medium jet bombers, with ranges of 4,320 miles; and a number of tankers. Many Tu-4 Soviet Superfortresses also remain in service.

Strategic Air Command of the USAF is said to have in operational service 450 B-52 Stratofortresses; about 1,250 B-47 medium jet bombers; and 120 KC-135 jet tankers. There are also several squadrons of KC-97 piston-engined tankers, while some 300 KC-135s have been built.

With the R.A.F. contribution, NATO strategic air strength is therefore considerably stronger than that of the Soviet Union, but this is probably because the Russian emphasis has been on missile development. In operational long-range missiles the West is still deficient.

B-70 in Eclipse

RECENT reports have suggested that development of the North American Valkyrie, the Mach-3 B-70 bomber for the U.S.A.F., was in jeopardy. The project has now suffered a serious setback; the U.S.A.F. announced on December 1 that only two prototypes of this bomber are to be built and that its first flight will be deferred until 1963 instead of 1962 as originally planned.

The U.S.A.F. said that the bomber was being "reoriented to a prototype program following a final review of weapons programs under the 1961 defense budget." This move will save about £30 million in the new budget, which will request £27 million for the project instead of the £57 million planned. Nearly £350 million will have been spent on the project by the time the first aircraft flies.

The decision suggests that the B-70 may never go into service. This could have important implications for the future of U.S. supersonic airliners. The immediate effect has been a cancellation of orders affecting many companies in the U.S. industry. All major sub-contracts will return to the North American Los Angeles Division.

Companies to lose orders are Boeing, for the wing; Lockheed, the upper fuselage; and Chance-Vought, horizontal and vertical stabilizers. Development of some major systems will be deferred. In this direction companies losing contracts are I.B.M., navigation system; Westinghouse, defensive system; and Motorola, mision and traffic control system. And as a result of the cutback 2,000 North American employees are likely to be dismissed.

Monkey in a Mercury Capsule

LAST week, a 7-lb. Rhesus monkey, named Sam, was very much in the news having been successfully recovered after a rocket flight to an altitude of 55 miles on December 4. Monkeys have been launched to greater heights before—Able and Baker, for example, travelled 300 miles into space on May 28 in the nose-cone of a Jupiter IRBM—but this occasion was unique in that Sam was a passenger in a Mercury capsule of the type scheduled to carry a man into orbit in 1961.

Although Atlas will be used for actual orbital experiments, a series of sub-orbital rockets is being used in initial experiments. The first is Little Joe, a solid-propellent test-vehicle which the Missile Division of North American Aviation developed in 4½ months. Its main purpose is to launch full-scale test models of the Mercury capsule to study bio-medical effects of acceleration, emergency separation of the capsule from its launching rocket, parachute deployment, and water impact.

The propulsion unit comprises four Thiokol Castors (improved Sergeants) and four Thiokol Recruits, fired in sequence. Launching is accomplished with two Castor rockets developing 120,000-lb. thrust; within ½-sec., four Recruits fire, giving an additional thrust of 132,000 lb. Then, as these burn out, the remaining Castors are fired.

In this way, the monkey was subjected to an initial acceleration of 8*g*, rising to a maximum of 19*g*. Separation of the capsule from the booster occurred at 160,000 ft. Finally, on re-entry into the atmosphere, a drogue parachute was deployed at 20,000 ft. and the larger supporting parachute at 10,000 ft.

Wings at the Waldorf

BOTH Houses of Parliament were prominently represented at the annual dinner of the Association of British Aero Clubs and Centres, at the Waldorf on December 2. The many club members present enjoyed a professional display of speech-making, the general tone of which was gently optimistic for private flying.

In such a friendly atmosphere it would have been nice to hear that the divergence which exists between the A.B.A.C. and the Royal Aero Club is being closed. As we have reported already the R.Ae.C. is to put forward a recommended specification for a light aeroplane. Meantime, it was announced at the dinner, the A.B.A.C. is doing the same thing. A common front could only encourage potential manufacturers, and, equally importantly, the construction of the necessary radio equipment.

The new Parliamentary Secretary in the Ministry of Aviation, MR. GEOFFREY RIPPON, M.P., led off with a word of hope that his department might come to be regarded as a Fairy Godmother to the Cinderella of club flying and deplored the fact that we were largely dependent on imports for up-to-date executive aircraft. He hoped that British manufacturers would become interested in a suitable specification drawn up by the A.B.A.C.

As President of the Association, VISCOUNT RUNCIMAN reminded his listeners that there were 72 air centres, 24 flying groups and 22 flying clubs affiliated to the Association, and in the year ending December 31, 1958, these had flown 88,000 hours.

Among the Association activities he mentioned were successful negotiations with the United Dominions Trust for hire-purchase terms on flying for a P.P.L. This would enable the course (at an approved flying club) to be done in the optimum time and the fees to be paid over 18 months (at 6% interest). Further details of the scheme are that facilities extend to refresher and advance courses up to a maximum cost of £200.

Viscount Runciman left no doubt as to the Association's unease at Government policy on private flying and also questioned both proposed and actual economics.

Toasting the guests, VISCOUNT BLEDISLOE especially welcomed Lord Ogmore, the last Minister of Civil Aviation, who had been largely responsible for the works' flying-club scheme. He also mentioned that two electronics experts at the M.o.A. were investigating a radio specification for club aircraft.

In welcoming the guests from Home Command he said that 2,680 cadets had been trained since the introduction of the A.T.C. scholarship scheme in July, 1950. The A.B.A.C. had put forward a specification for a replacement club aircraft which could also be used for touring and were confidently awaiting its approval.

LORD OGMORE gracefully replied.

The President presented the Lennox-Boyd Trophy to WG. CDR. R. J. B. PEARSE, of the Exeter Aero Club. Close runners-up were Fair Oaks, Surrey, Elstree and Southend.

The Little Man in Flying

THE annual dinner and dance of the Elstree Flying Club was held at the "Green Man," Kingsbury, on Dec. 4. This is always a very popular affair and tickets were sold out some weeks ago.

MR. M. COLBECK, Southern Divisional Control, M.o.A., who deputized for Mr. Sandys, commented upon the changing pattern of private and executive flying and of the increasing awareness of everyone to the need for radio in all aircraft that went beyond the boundaries of airfields. For example, he said, Elstree was going to fit radio in its control tower, and to employ an air traffic control officer.

Mr. Colbeck, expressing the view that the manufacturers of aircraft and radio now realized the need for good, reasonably priced, equipment, believed himself that there would be the right things on the market before long. With the right aircraft and equipment—and a proper appreciation of the need for reasonable discipline in the air—there was undoubtedly a real future for the little man. To this end the Elstree Club was already making useful steps by the improvement of its airport facilities.

Towards the Mach 3 Airliner

Britain's All-steel Research Prototype

CONTRARY to normal practice, details of Britain's latest research aircraft have been revealed before its first flight. This week comes news of the Bristol 188 intended for research at speeds greater than 1,500 m.p.h.—above Mach 2.3 in the stratosphere—and with a structure of welded stainless steel. A large single-seat aircraft with two de Havilland Gyron Junior DGJ.10 turbojets in wing-mounted nacelles, the Bristol 188 will make its first flight next year. It has not been revealed how many Bristol 188s will be built, but in the past it has been customary to produce two of each research aircraft: this was done with the Fairey F.D.2 and Saunders-Roe S.R.53, for example.

Development of the Bristol 188 goes back to the early 1950s when it was envisaged as a military research aircraft for structural, aerodynamic and propulsion studies. In evidence before the 1956 Select Committee on Estimates it was mentioned as a "straight thin-wing aircraft built in steel." In the list of research projects examined by the Committee it came between the Rolls-Royce Flying Bedstead and the Short SC.1 VTOL aircraft, suggesting that its origins go back perhaps seven or eight years.

It has been suggested that the Bristol 188 was associated with the development of the Avro supersonic bomber, which was cancelled at the time of the 1957 Defence White Paper. In fact, the Bristol aircraft pre-dates the development of the Avro bomber, as the Select Committee report indicates.

As its background suggests, the long gestation period of this aircraft has been caused to some extent by changes in official policy and requirements. Also the need for a suitable powerplant and production techniques for a stainless steel structure —it is the first British aircraft with this type of structure— have stretched its development time.

A thorough programme of aerodynamic and structural study has been necessary for the Bristol 188 development. Fabrication techniques for high-temperature, high-strength materials were evolved and other new materials, methods and aircraft systems developed. Firth Vickers F.V.520 stainless steel is used for the Bristol 188's airframe; this steel has a maximum service temperature of 500° C.

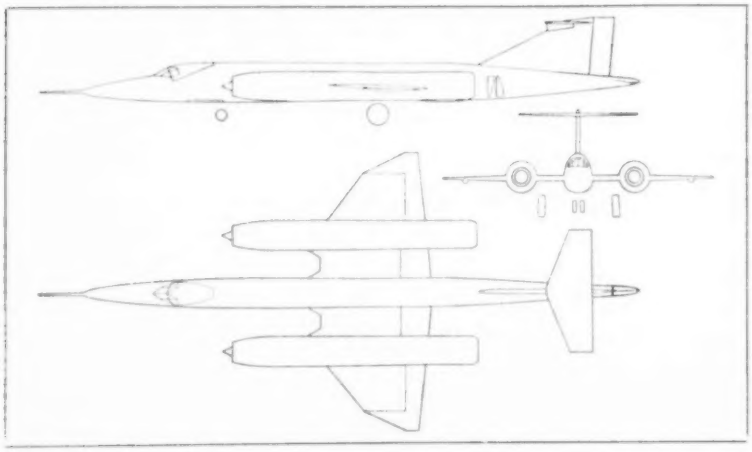
In addition to the structural programme, some 20 wind-tunnel models were tested to assess the subsonic and supersonic behaviour of the aircraft and to examine aeroelastic problems. Free-flight flutter tests were made at the R.A.E., Aberporth, with rocket-boosted free-flight models. A photograph of a Bristol 188 flutter model was published in THE AEROPLANE for June 6, 1958.

Reminiscent in configuration of the Canberra, the Bristol 188 is a large aircraft probably weighing 40,000 lb. or more even though it is only a single-seater. It has an oval-section fuselage which is 71 ft. long and has a maximum width and depth of 3 ft. 9 in. and 4 ft. 11½ in. respectively. Its wing is 4% thick and has a modified biconvex section. The span is 35 ft. 1 in. and wing area is 396 sq. ft.

Large and long engine nacelles are mounted on the wing. Between the fuselage and the nacelles the leading-edge is unswept, although there are swept extensions at the fuselage and nacelle sides. There are trailing-edge flaps on this section of the wing. Outboard of the engines the leading-edge has 38° sweep. Ailerons extend from the nacelles to the wingtips; they are balanced by all-moving wingtips having a 64° leading-edge sweep and square-cut tips.

The wing planform was chosen for its low wave drag at supersonic speeds and good transonic characteristics. The shape of the aircraft suggests a good area-rule distribution; there is a small degree of fuselage waisting in line with the engine nacelles. The design allows for favourable shock-wave interaction between fuselage and nacelles to reduce supersonic drag. The nacelle mounting of engines also makes it easier to install and test alternative powerplants.

An all-moving tailplane is mounted above the fin, which has a 65° leading-edge sweep. The conventional trailing-edge rudder has a constant chord. The lengthy fuselage contains the cockpit, test equipment, nose and main units of the undercarriage, fuel tanks and all major items of equipment. A large part of the fuselage volume is doubtless filled with fuel, as the wing is only about seven inches thick and probably holds no fuel tanks. Total engine static thrust with



FAST CRAFT.—The Bristol 188's air-brakes are mounted on the fuselage side behind the wing; a brake parachute is stowed in the tail cone.

reheat is 28,000 lb., indicating a high rate of fuel consumption.

Extreme length characterizes the engine nacelles for the de Havilland Gyron Junior DGJ.10 turbojets and their afterburners. This engine, designed specificallly for supersonic flight, has a frontal area of less than 6 sq. ft., a relatively low compression ratio and a very efficient reheat system. Its maximum static thrust is 10,000 lb., which is increased to 14,000 lb. by the 2,000°K variable reheat system. Its thrust augmentation at Mach 2.5 approaches 200%.

Gyron Junior DGJ.10s are being run in supersonic flight conditions at the N.G.T.E. test facility; others have been mounted in a Javelin for subsonic flight testing. The first flight of the Bristol 188 will not be made until sufficient flight experience has been gained with these engines.

A centre-body intake is used for the Gyron Junior; the intake bullet may possibly be fixed for early test flights, but doubtless a variable-geometry system will be needed if intake performance is to be acceptable over the ultimate range of flight speeds.

Aerodynamically, the Bristol 188 appears to be outdated by the slim-delta shapes now favoured for supersonic transports. But it is the first British aircraft intended for sustained flight above Mach 2. As in all test programmes, its speed will be increased gradually, and Mach 2 flight is unlikely initially.

It should give invaluable information on kinetic heating, stainless steel structures and propulsion in the Mach 2 to Mach 3 speed range. This should be invaluable for the supersonic-transport programme as well as for future military aircraft if by any chance current defence policies are reversed.—J.R.C.

Tigers in the Club

NORMAN JONES presided at the annual dinner of the Tiger Club on November 27, at the Royal Aero Club, where the occasion took on much of the atmosphere of a *conversazione*. As he said in his opening remarks, the Tiger Club is an extraordinarily casual organization, and a good percentage of those present contributed casually to the evening's speeches.

In the course of these, JANET FERGUSON was presented with the Tiger Trophy for her contribution to private flying; C. A. NEPEAN BISHOP mentioned the club activities at re-opened Redhill; COLIN LABOUCHERE hinted at possible C.F.S. participation in the next Lockheed Aerobatic competition; and EDDIE MCCAULEY described his tuition by aerobatic champion Biancotto on the Continent.

MAJOR OLIVER STEWART was delighted to see the British at last getting somewhere in international aerobatics, after NORMAN JONES had described progress, with A.R.B. help, on a top-wing-aileroned Tiger Moth. Former racing champion BRIAN ILES said that the secret of winning races was to have a dirty aeroplane and an honest face.

Other speakers included BILL CHESSON, JACK PIERCEY, and WG. CDR. TICH HOLMES (who lamented the non-issue of a Permit-to-Fly for the Taylor monoplane, which had done about 40 hours' flying), MIKE REILLY talked parachuting, BRENDA HORSFALL gliding, and AIR CDRE. CHRISTOPHER PAUL public relations, while Esso's DOUGLAS WARD-CAMPBELL promised further encouragement for these ultra-enthusiasts.

The McKenna Dinner

THE graduates of No. 18 Course of the Empire Test Pilots School proved that their standard of after-dinner speaking was as high as their flying skill, when the McKenna Trophy was presented by SIR FREDERICK HANDLEY PAGE on December 3. The retiring Commandant, GP. CAPT. BURNS, said that the 1959 course had proved a vintage year for quality, with five distinctions, no suspensions and an overall standard of 75.5%.

After many years, the McKenna Trophy had at last been won by the R.A.F., in the person of SQN. LDR. H. R. RADFORD, and the Edwards Trophy went to FLT. LT. J. M. HENDERSON. A mention of the desirability of a V-bomber at the school to provide four-engine experience brought a quiet "hear hear" from the ever-alert guest of honour. Because of the expense, however, training was confined to fighter-type aircraft. The Commandant might also have mentioned the four hours' helicopter training given to each student.

The latest working party on the future of E.T.P.S. had recently announced that the School must continue for the foreseeable future, and estimated only a 10% decrease in the demand for test pilots by 1965.

This point was joyfully seized upon by Sir Frederick, who hoped that the decrease in military aircraft would be correspondingly small. He also congratulated the Swedish member of the course, who had a slight contretemps with a Canberra, for helping to keep the manufacturers in business. On a more, but not very, serious note, he dealt with the need for cheap air fares to make possible all-the-year-round holidays in the sun and mentioned the work towards this end done by his company on laminar-flow wings.

The remainder of the speech-making did not lend itself readily to literary transcription, but to say that it was in the best tradition of similar past occasions will perhaps give some indication of its quality.—J.E.F.

Sopwith Apprentices Dine

A UNIQUE occasion in the aviation calendar, the Sopwith Apprentices' Association's annual dinner has become established as a notable gathering of a select group that can lay claim to have been associated with the beginnings of British aviation. The fifth of these enjoyable functions was held in London last week and 18 of the original Sopwith apprentices were present. Among their guests were Sir Thomas Sopwith, Sir Frank Spriggs and Sir Roy Dobson.

After the assembled company had drunk a silent toast to Fred Sigrist—the Association's first president—AIR VICE-MARSHAL L. T. PANKHURST, C.B., C.B.E., proposed the health of their president, Sir Thomas Sopwith. He spoke of his leadership and wisdom and remarked that Sir Thomas had been in the forefront of aviation for half a century. In reply SIR THOMAS SOPWITH paid a tribute to his team. The secret of running a big organization—or a small one, for that matter—lay in finding some fine people to do the work.

MR. J. BEWSHER had something nice to say about all the guests in his toast to them. MR. J. T. LIDBURY, who replied, expressed the feelings of all the guests when he said that they looked forward every year to hearing stories of the early days.

MR. R. W. SUTTON proposed the toast to Hawker Aircraft and not only succeeded in recalling many memories of the past, but paid handsome tribute to the founders of the company. SIR ROY DOBSON replied and in his inimitable way had something to say about Hawkers, the Sopwith tradition and the Government.

The health of the Association was proposed by SIR THOMAS SOPWITH and the reply was made by MR. J. H. WILLIAMS. And throughout the proceedings, before, during and after dinner, the entire company indulged in vigorous reminiscences.

AT THE
R.A.F. RESERVES CLUB DINNER
HOUSES OF PARLIAMENT
NOVEMBER 27, 1959
Marshal of the R.A.F. SIR DERMOT BOYLE CAS
SIR ARCHIBALD McINDOE President

AN unusual venue, the Houses of Parliament Members' Dining Room, contributed to a large attendance at the R.A.F. Reserves Club dinner on November 27, when their host was Mr. Dudley Smith, M.P.

MARSHAL OF THE R.A.F. SIR DERMOT BOYLE was in his best Guest Night form and on the light-hearted premise that "The modern R.A.F. is good enough to prevent the disaster of having to call on the Reserves for help," listed such Service achievements as the supremacy of 111 Sqn.'s aerobatics, winning the Reconnaissance Competition in Germany, the lowest accident rate on record, and practically sweeping the board in inter-Service sporting events.

SIR ARCHIBALD MCINDOE thanked the Air Council for cancelling the Club's debt and hoped for more and younger members.

THE HON. MAX AITKEN spoke warmly of Lord Dowding, president of the Battle of Britain Fighter Association, and wished that he could have attended.

MAJOR-GENERAL E. MOORE agreed with Sir Dermot that the two Air Forces had never been closer, and noted the unified flying control in this country, where the U.S.A.F.'s presence brought in some $213 million annually, more than from any other source. "And," he added, "there have been on this side of the four-hour pond, over 2,600 marriages."

Among the 200 members and guests were Air Chief Marshals Sir Guy Garrod and Sir John Baker, Air Marshal Sir Edward Chilton, Sir Frederick Handley Page, Sir Frederick Tymms and the leaders of the R.A.F.'s winning Blériot Race team, Gp. Capt. Norman Ryder and Sqn. Ldr. Charles Maughan.

General Aviation News

(1) An operational prototype of the Lockheed P3V-1 anti-submarine aircraft, developed from the Electra, has made its first flight; it has a 10-man crew. (2) Two prototypes of the Bastan-engined M.S.1500 Epervier (Sparrowhawk), designed for Army support duties, are now undergoing flight test. (3) A new East Africa Lodge of the Guild of Air Traffic Control Officers was inaugurated on November 24—here, Mr. J. A. R. King (left) presents the warrant of constitution to the first Master, Mr. T. R. Thomson; centre, is Mr. E. B. David, the Administrator of the East Africa High Commission.

NIGHT SHOT. — An R.A.F. crew successfully fired a Thor IRBM at night from Vandenberg on December 2 under simulated battle conditions. It was the ninth Thor to be launched by R.A.F. personnel.

CAPSULE CONSTRUCTION. — Materials used in the Mercury man-in-space capsule include laminated glass fibre for the ablation "heat shield"; nickel cobalt for the capsule's outer skin, and titanium for the inner pressure chamber.

CENTAUR. — Initial ground tests have been made of the XLR 115 liquid oxygen/liquid hydrogen engine being developed by Pratt & Whitney for the Atlas-Centaur rocket. The engine is also scheduled for use in an upper stage of the giant 1.5-million-lb.-thrust Saturn booster.

SKYLARKS ALOFT.—Three Skylark high-altitude rockets were launched from Woomera on November 30 and December 1 as a British contribution to an international COSPAR research programme. Instruments carried included apparatus for measuring atmospheric temperature, electron densities and wind structure.

SPACE COMMUNICATOR. — Next spring it is hoped to establish an experimental trans-oceanic radio-link between Jodrell Bank and the east coast of North America and Hawaii and America's west coast using 100-ft.-dia. inflatable satellites. Object of the experiment is "to test the feasibility of a passive reflector communications system on a global basis." It is hoped to launch the satellites at a height of 1,000 miles using the newly developed Thor-Delta.

ALTITUDE RECORD.—A U.S. Navy McDonnell F4H Phantom II flown by Cdr. Lawrence Flint, reached a height of 98,560 ft. on December 6. Subject to official recognition, this is a new altitude record, beating the previous Russian record of 94,658 ft., established in July by a TU-431.

HUSTLING.—During a recent high-altitude flight a Convair B-58A Hustler covered 1,680 st. miles in 80 min., an average speed of 21 miles per min. Refuelled by a Boeing KC-135 tanker, the B-58 is reported to have flown in excess of Mach 2 for more than 1 hr.

R.A.F. LIGHTNING SIMULATOR. —A prototype flight simulator of the English Electric Lightning is being installed at R.A.F. Coltishall. Designed and built by the Air Trainers Link Division of General Precision Systems, Ltd., the prototype is the first of a number ordered by the Ministry of Aviation for Fighter Command.

AIRPORT DEVELOPMENT. — The U.S. Federal Aid Airport Program for the fiscal year 1960 includes 288 airport construction projects to be financed jointly by the U.S. Government and local bodies. The Federal grant totals $57 million, of which 38% is for runway construction, 34.1% for taxiways and aprons, and 16.7% for land acquisition.

MEMORIAL FUND.—A fund has been organized by Air Charter, Ltd., to assist the children of those crew members who were killed in one of the company's aircraft which crashed on Mount Suphan in April, 1959. Donations to the Mount Suphan Memorial Fund will be gratefully received by Capt. J. M. Carreras, 21 Wigmore Street, London, W.1.

ROTODYNE SETBACK. — Fairey Aviation has told the M.o.A. that it is not prepared to proceed with the Rotodyne under the terms of the £4m. development contract arranged last August and has asked for additional Government financial assistance.

CANADIAN HELICOPTERS. — On November 13 we published a news item stating that the Sikorsky HR 3S-1 transport helicopter had been ordered for military use in Canada. This was the result of a misunderstanding. An announcement from the United Aircraft Corporation had stated that "Canadian Pratt & Whitney had concluded arrangements with Sikorsky Aircraft to produce a substantial portion of the HR 3S-1 in Canada for Canadian military orders." In fact, it is understood that the military order for helicopters has yet to be placed in Canada.

U.S.A.F. CUTBACK.—Approximately 900 U.S.A.F. aircraft, mostly combat types, are to be taken out of service during the next year, and twelve air bases are to be closed. Announced last week, this cutback is one of several recently introduced by the Defense Department.

Commercial Aviation Affairs

COMET PROVING.—A B.E.A. 4B made its first proving flight to Moscow on December 5, returning to London non-stop in four hours. The flight was one of a series being made last week and this over the future Comet network to 14 cities in Europe and the Middle East.

NEW COMET SERVICES.—B.O.A.C. inaugurated its Comet service to Johannesburg on December 2 with four services a week, one via Rome, Khartoum and Nairobi, and the others calling at Salisbury also. The service to South America, twice weekly, begins on January 25 and in February B.O.A.C. will inaugurate six services a week from New York to Montego Bay, Jamaica, including three via Nassau. The 17th Comet of the B.O.A.C. fleet of 19 was delivered on November 28.

APPROVAL FOR 707-220.—The F.A.A. has approved the Boeing 707-220 for airline operations. Braniff International has ordered five of these JT4A-engined 707s, one of which crashed on a training flight on October 19.

B.O.A.C. 707 PLANS.—B.O.A.C. plans to start Boeing 707 services between London and New York in mid-April, 1960, building up from three weekly to daily by mid-May. A weekly service to Montreal and Toronto begins in April also, increasing to daily by August, and extending to Detroit and Chicago in September. Additional services to New York, starting in July, will call at Prestwick or Boston. In September, a twice-weekly service to San Francisco via New York will begin, and will extend to Tokyo and Hong Kong in November. In 1961, 707s will fly to Nassau from New York, to Los Angeles from London and to the Middle East as an extension of the Atlantic services.

APPROVED SERVICES.—Normal scheduled services recently approved by the A.T.A.C. for six- or seven-year periods are: Glasgow-Ostend, by B.K.S.; Liverpool-Ostend, by B.K.S.; Cardiff-Bristol (optional)-Ostend by Derby Aviation (seasonal) and Southend-Groningen, by Tradair.

CONVAIRS FOR LINJEFLYG.—Part of the transaction in the sale of six S.A.S. DC-6s to Aeronaves (see issue of November 27, p. 530) by the Babb company involved the sale of four Convair 340s, traded-in to Linjeflyg, the Swedish domestic operator.

THAI INTERNATIONAL.—Formation of Thai International Airways by the existing Thailand Airlines and S.A.S. has been confirmed. Operations will begin in April, 1960, with three DC-6Bs.

ANOTHER 707 FOR AIR-INDIA?—A fourth Boeing 707-420, for delivery in mid-1961, is, it is reported from Bombay, to be ordered by Air-India International.

C.A.A. COMET.—B.O.A.C. Comets are now being used for one Central African Airways service a week between London and Salisbury, via Nairobi, Khartoum and Rome. The first service flown in C.A.A. colours left London on December 4.

EDWARD WARNER AWARD.—The late Dr. Albert Plesman has been named first recipient of the Edward Warner Award, a gold medal to be bestowed biennially by the Council of ICAO. The award is made for "outstanding contributions to the development of international civil aviation."

N.Z. DOMESTIC FARES.—The Air Services Licensing Authority has granted the request of the New Zealand National Airways Corporation for a 10% rise in passenger fares and freight rates. This increase is expected to yield an additional £450,000 annually in revenue. No objections were made to the application. The increases become operative on January 1.

BOEING LOG.—By November 23, Boeing had rolled out 91 of its 707s and had delivered 74 to customer airlines. Best average daily utilization, according to Boeing, is Continental's 9.9 hours.

K.L.M. NEWS.—In the third quarter of 1959, K.L.M. carried 10% of all passengers on the North Atlantic route, taking fourth position among Atlantic carriers. The airline has recently received approval to run its Dart 510s for 2,500 hours between overhauls—the highest figure authorized to date.

ALLEGHENY ACCIDENT.—A Martin 202 of Allegheny Airlines crashed in bad weather while attempting to land at Williamsport Municipal Airport, on December 1. Of 25 occupants, one passenger survived, with serious injuries.

News About People

ROYAL PUPIL.—Crown Prince Muhammad of Jordan has completed a course of helicopter pilot training. His instructor was Lieut. Cdr. R. S. Bradley, Westland's assistant chief test pilot who, during his eight week stay in Amman, used King Hussein's private Westland Widgeon for the instruction.

NEW FAIRCHILD DIRECTORS.—Leo W. Killen has been appointed sales director for the aircraft and missiles division of the Fairchild Engine and Airplane Corp. According to an announcement by J. H. Carmichael, the president, "Killen's responsibilities will include military relations, F-27 and sub-contract sales."

M.o.A. APPOINTMENT.—Gp. Capt. E. M. T. Howell has been appointed Director of Air Armament Research and Development, with effect from January 1, 1960, and with the acting rank of Air Commodore. He succeeds Air Commodore R. H. E. Emson.

Wing Commander J. L. Dell.

A.T.A. BENEVOLENT FUND.—Sir Gerard d'Erlanger was re-elected chairman and Mr. P. A. Wills was re-elected vice-chairman of the A.T.A. Benevolent Fund at the 28th meeting of its general committee. The Fund is expected to be wound up by 1963.

E. E. APPOINTMENTS.—English Electric Aviation, Ltd., have appointed Mr. J. O. Charlton secretary of the company; and Wing Commander J. L. Dell is to become deputy chief test pilot.

PLESSEY PRIZE-GIVING.—Mr. R. Hall, speaking at the Plessey apprentice prize-giving ceremony said that the company now had 96 apprentices under training; 119 applications for apprentice training had been received during 1959, but it had only been possible to take on 29 of these. Next year, the total number of apprentices at the Swindon factory would exceed 100.

A VETERAN RETIRES.—Captain Henry J. Johnson has retired from B.E.A. after 28 years in commercial aviation. His first contact with flying was as manager of Hillman Airways, in the development of which he played a leading part. Subsequently, he became senior traffic officer of British Airways and held a similar post with B.O.A.C. He has held various appointments in the commercial and sales departments of B.E.A. since 1946.

DERYK SMITH.—It is with great regret that we record the sudden death in Paris last week of Deryk Smith, the executive officer of AGARD's Structures Panel. Until he went to Paris in 1955 he was head of the technical department of the Royal Aeronautical Society.

FAIREY PRESENTATION.—Mr. Alan Vines, a director of the Fairey company presents P. L. Doughty with an award during the annual presentation of awards to Fairey students on November 25.

Air Transport

The Electra in Europe

THE effects of the appearance of the new generation of turboprop-powered aeroplanes on the air transport pattern within and out of Europe will be interesting to watch. For rather too long the attention of airline sales executives, and, consequently, of the prospective travelling public, has been directed to the turbojet and it may well be that K.L.M.'s new Electras and, later, B.E.A.'s Vanguards will have a surprising impact—even in an artificial environment in which fare-differentials and fare-competition are taboo.

K.L.M. now have three L-188C (International) Electras ("Mercurius," "Venus" and "Mars") and a fourth ("Jupiter") is due later this month. The programmes of crew-training and sales promotion are now well under way and the first service, on the Amsterdam-Cairo run, will be flown on December 15. In due course the Electras will be used on all the heavier traffic European routes and on the medium-long-haul-sector services to the Middle and Far East.

A 50-minute trip from Schiphol, Amsterdam, to Le Bourget, Paris, last week left at least this person convinced that the Electra is going to hold its share of the available traffic—and more than its share if a maximum sales and passenger-service effort continues to be made. The regular traveller is going to be more concerned with time-table regularity than with the *nuances* of relative noise and vibration levels; the first-time traveller (who will have left his sensitive decibel recorder at home) will find that the ride is impressive by any standards; and the sophisticated, technically minded (and therefore knowledgeably nervous) traveller will appreciate the unchanging engine note from the constant-speed engines.

The normal K.L.M. layout will be for 16 first-class and 53 tourist-class passengers. The first-class compartment is at the rear, on each side of the galley and auxiliary entrance area, and behind a movable bulkhead. In fact, almost any variation of arrangement, from 66 to 99 seats, can be organized during turn-round, and the aircraft on the demonstration flights to and at Paris had 66 + 2 five-abreast seats in two compartments and eight (very) first-class seats aft of the galley. With or without the movable bulkhead, the interior is broken down by the lavatory, coat-cupboard and carry-on luggage area in the plane of the propellers and by the galley/bar area at the rear entrance—so there is nothing of the tube-train appearance. There is another coat-cupboard and two lavatories at the rear of the cabin. The normally used entry and exit door is forward on the port side.

The flight-crew complement will be two pilots and a flight engineer—with a navigator carried on the longer-haul flights or in areas where navigation aids are limited. The engineer's position is behind the wide control console. K.L.M., incidentally, carry flight engineers on all aircraft except the Viscount 803s, which have a two-crew arrangement and for which all pilots are given a special engineering course.

The flight equipment of the Electra is in line with that of present and future units in the K.L.M. fleet and includes the Sperry Integrated Instrument System and Bendix autopilot. Amongst the modern items of Electra equipment is a system for "one-shot" engine-failure drill in which one control is used to complete all the shut-down operations.

On the positioning flight from Amsterdam to Paris the Electra's take-off weight was about 100,000 lb.—or 16,000 lb. less than maximum—and the take-off and climb to operating altitude were nothing if not vigorous. It is lifted off into a steep initial climb which is held—except for an almost unnoticeable reduction of angle to maintain the best climbing speed—until the aircraft has settled into level flight at the chosen cruising altitude, when there is still no change in engine note. A most comforting programme. Our cruising altitude for the short sector was 20,000 ft., which was reached in about nine minutes from start of take-off. At maximum weight the time to 10,000 ft. is about six minutes. The flight-planned time of 48 minutes gave a block speed of 316 m.p.h. for the 253-mile sector.—H.A.T.

PHILIPPINE DELIVERY.—A fleet of five Scottish Aviation Twin Pioneer Series 2s was handed over to Philippine Air Lines on November 27 at Prestwick. Powered, at P.A.L.'s request, by R1340 Wasp engines, these 19-seat Twin Pioneers are to be ferried to Manila by Scottish Aviation crews. In this group, Mr. T. D. M. Robertson, managing director, and other Scottish Aviation executives are seen with representatives of the airline.

Defence Against Competition

FOLLOWING the North Atlantic service agreement with Trans-Canada Air Lines (see last week's issue, p. 558), B.O.A.C. has reached agreement on a pooling scheme for eastern and Atlantic services with Air-India International and Qantas Empire Airways. Subject to government ratification the agreement will come into force on April 1 next year.

The network which is involved extends between London, India, Hong Kong and Japan, between London and Australia, and across the North Atlantic. Tickets will be interchangeable and each airline will sell the services of the others whilst maintaining its individuality. B.O.A.C. and Qantas already have turbojet flights on these routes and Air-India will introduce such flights next April. The three airlines will co-ordinate their operations in a drive to increase their total traffic.

Such agreements appear to have become inevitable in an era in which nearly all long-haul airlines have over-equipped with turbojet fleets which cannot begin to show a profit until the introductory period is over and until more traffic has been obtained to match the increased available ton-mile capacity.

The Cost of Re-equipment

SOME eyebrows may have been raised at a small entry on the very last page of the B.O.A.C. *Report and Accounts 1958/59*, in which it is recorded that contractual commitments in respect of future aircraft purchases include £89.3 million for the VC10s and £34.7 million for the Boeing 707s. By comparison, the commitments for these same orders were shown in the 1957/58 accounts as £56.6 million and £24.7 million.

No explanation is given of these increases, nor is it explained that even these figures are far from being final. In fact, the current totals, as given to us by B.O.A.C. last month, are £95 million for the VC10 and £43.4 million for the Boeing 707. The explanation, it seems, is that the published figures are based on actual contract commitments up to the end of the financial year, and not on the estimated total cost.

The total of £95 million for the VC10s is made up of £60 million for the basic 35 aircraft (with engines); £4 million for customer-furnished equipment; £8 million for agreed modifications since the contract was signed (including a change from Conway R.Co.15 to R.Co.42 engines); £4 million for price escalation (the rising cost of material and labour); £8 million for spare engines (approximately 100); and £11 million for aircraft spares and ground equipment.

The increase in the Boeing 707 price is similarly explained. Current total cost of the 19 Comet 4s for B.O.A.C. is given as £34.7 million.

London Airport Jet Movements

IN the year ended September 30, 1959, there was a daily average of 318 movements at London Airport. These movements were broken down as follows, in a recent written answer in the House, with "night" defined as 23.00 hrs. to 07.00 hrs.:

October, 1958-March, 1959.
Arrivals, 113 day (1.2% jet); 11 night (2.3% jet).
Departures, 112 day (1.4% jet); 14 night (0.8% jet).

April-September, 1959.
Arrivals, 162 day (3.3% jet); 31 night (1.1% jet).
Departures, 163 day (3.4% jet); 30 night (0.8% jet).

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AIRLINE OPERATORS are invited to look carefully at this diagram and graph, and then compare the Vanguard's flexibility with their own experience of short haul operation on high-density routes.

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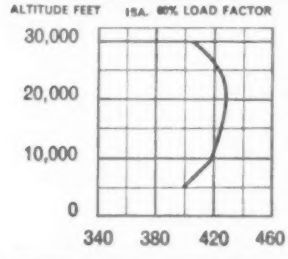
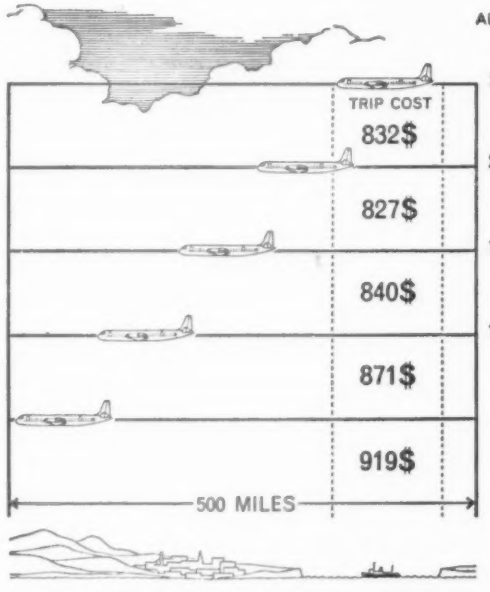
The difference in direct cost between a 500-mile sector flown at 10,000 ft and one flown at an optimum of 20,000 ft is only $44 per trip. A cruising speed of over 400 m.p.h. is available between the height bands of 5,000 ft and 30,000 ft., so that schedules can be maintained irrespective of routeing instructions.



SPEED CAN BE MAINTAINED WHATEVER THE ALTITUDE ROUTEING INSTRUCTIONS



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Air Transport . . . .

T.W.A. Jet Operations

TRANS WORLD AIRLINES became the fourth carrier to offer jet service over the North Atlantic on November 23, when it introduced its Boeing 707-331 Intercontinentals between New York, London and Frankfurt. The inaugural westbound service from London, a day later, provided an opportunity for THE AEROPLANE AND ASTRONAUTICS to study the operation at first hand and later, in Kansas City, to see something of the company's extensive training and engineering programmes which support the jet operations.

Initial jet schedules across the Atlantic are three round services a week between New York, London and Frankfurt, with scheduled flying times of 6 hr. 25 min. eastbound and 7 hr. 30 min. westbound for the ocean crossings. In January, 1960, the schedules will be increased to provide a daily service, with two flights a day in the spring and summer peaks. On December 3 a second Atlantic service, between New York, Paris and Rome, was inaugurated—also with a thrice-weekly frequency. T.W.A. has been using its fleet of 15 smaller 707-131s since March 20 on domestic routes in the U.S.A., and the average monthly passenger-load factor on the jets has never been below 80%. By comparison, the average on piston-engine aircraft in 1958, and so far this year, has never been above 80%.

It is claimed for the Intercontinental that it is "the World's first civil jet aircraft to offer a non-stop service across the Atlantic in either direction, regardless of weather conditions." T.W.A. was less than lucky, on its first London-New York service, to encounter a combination of conditions which made it necessary to stop at Gander and so disprove this claim. The weather at New York was, at the time of leaving London, below minima for the particular crew flying the Intercontinental, and was clearing only slowly. The declared alternate, Pittsburgh, was at the limit of the Intercontinental's range for this flight, which was made against a 40-knot average headwind component, with almost a full passenger payload, and a weight limitation out of London.

The flight was therefore planned with a refuelling stop at Gander and arrived in New York some two hours behind schedule. Terminal weather should be the only factor limiting non-stop service with the Intercontinental on the North Atlantic, although the full weight of 301,000 lb. cannot be used at present out of London, Paris, or Rome. In standard conditions the field length required at this weight is 10,075 ft., compared with the 9,576 ft. of London's longest runway, 28L.

T.W.A. operates its Boeing 707s with a flight crew of five, comprising captain, first and second officers, flight engineer and navigator. The second officer, who is qualified to fly the 707 from the right-hand seat, sits behind the captain and is principally concerned with handling communications, as well as meeting the F.A.A. requirement for two pilots on the flight deck throughout the period of every journey.

The normal cabin crew also totals five—two for the 102-seat economy-class cabin and three for the 32-seat de luxe-class cabin forward. An attractive feature of the de-luxe cabin is the spacing of the seats, which, on the port side of the aisle are, in effect, three-abreast but with the centre seat replaced by a handy two-tier table. Double seats, without these tables, complete the layout to starboard. Between the forward cabin and the flight deck there is a six-seat lounge, a galley and two toilets. Additional galley and toilets at the rear serve the economy-class cabin, where the seating is six-abreast at the IATA-prescribed 34-inch pitch.

Flight Planning

T.W.A. operates its jets on the basis of a fixed-altitude cruise at a speed approximating to that for minimum cost, adjusting engine power (indicated as a percentage of compressor r.p.m.) at intervals to maintain this speed at a constant value. Cruise-climb operations are not attempted because of the difficulty of obtaining A.T.C. clearance, but a stepped climb, usually comprising one 4,000-ft. increase in altitude, is used when the aircraft is too heavy to reach the optimum altitude on its initial climb. In practice, a cruise at Mach 0.82 at an altitude of around 30,000 ft. is usually the optimum operation. When payload and weather are not critical, maximum-speed cruise (MSC) can be used, with the engines at maximum-cruise thrust, while a long-range technique (LRC) is used when it is necessary to conserve fuel.

Flight planning is worked out on the T.W.A. Jet Flight Plan—Flight Log, which combines the functions of a "Howgozit" chart. On this chart, the first steps are to record the selected route, type of cruise and cruising altitude for the flight, and the selected alternate. The flight from destination to alternate is always assumed to be at LRC power. Ground distances, average temperatures and average wind components for the scheduled sector and diversion to alternate are entered on the sheet, and the total time and fuel for the alternate operation are then calculated with the help of tables in the Jet Planning and Performance Manual.

The first item in the weight calculation entered on the chart is, therefore, the fuel required for operation from destination to alternate, including climb, cruise and descent. Additional reserve fuel is then listed under the headings of "F.A.A. reserve," "T.W.A. reserve" and "Hold-Destination." The combined F.A.A./T.W.A. reserve varies according to operation;

The facility at Mid-Continent International airport, Kansas City, is the principal T.W.A. overhaul base for aircraft (top right) and for power plants (centre foreground). Boeing 707s are receiving their major overhauls at this base, and work on jet engines will begin next year.

on domestic flights with the 707-131, it is 10,000 lb.; on international flights of less than five hours' duration, it is 12,000 lb.; for five to eight hours it is 15,000 lb.; and for flights of more than eight hours, reserve fuel is added at the rate of 18 lb./min. of extra flight time.

The "Hold-Destination" reserve fuel is at the captain's discretion, to allow for anticipated delays at destination calculated on the basis of 10,000 lb. of fuel per hour of holding time. On domestic flights, incidentally, no alternate need be planned if, for a period from 2 hr. before to 2 hr. after the E.T.A. at destination, the ceiling is forecast at least 1,000 ft. above the initial approach altitude and visibility at least three miles.

By adding together the various reserve fuel allowances, the aircraft operating weight empty (either the fleet average or a specific value for the flight if known) and the estimated payload, the landing weight at destination can next be calculated. From this information, using flight-planning charts for the appropriate altitude, temperature, ground miles and cruising power, the true air speed can be obtained. The wind component is applied to this figure, the nautical air miles calculated and the time and fuel for the scheduled sector can then be read from the tables in the manual. The gross weight at take-off is finally obtained by adding this fuel weight (and, on the 707-131, injection-water weight) to the landing weight.

It will be seen that the T.W.A. operations are based on a generous fuel-reserve policy, including sector fuel from take-off to landing; fuel for the alternate, allowing for climb back to cruising altitude from destination and descent to alternate; a variable holding reserve and a fixed final reserve depending on the length of flight. Flight planning is straightforward when using the Jet Planning and Performance Manual, in which the tables give the answers for any set of conditions.

Before take-off, the Flight Log portion of the Flight Plan sheet is completed with all compulsory A.T.C. check points, their distance from take-off, the estimated T.A.S. and ground speed in knots over each point, time between each point, estimated clock time and naut. miles remaining. Other information, such as actual time overhead, actual altitude, T.A.S., ground speed, outside air temperature, cruising power in use and fuel remaining are recorded at each check point. In this way a constant watch is kept on the progress of the flight—and a permanent record is available for subsequent analysis if desired.

For each take-off, a Take-off Data card is completed, and is prominently displayed in the cockpit. It records the gross weight, temperature, altimeter setting, airfield pressure, tailplane incidence setting, appropriate engine speeds, V1 and V2 speeds and time to 120 knots. The reverse of this card tabulates V2 speeds for various weights (ranging, on the 707-331, from 135 knots at 190,000 lb. to 163 knots at 301,000 lb. with 30° flaps) and the boundary speeds (from 118 knots at 150,000 lb. to 135 knots at 198,000 lb. with 50° flaps).

Normal take-off procedure is to climb to 1,200 ft. at reference speed plus 10 knots before retracting flaps and then to climb at 280 knots to about 25,000 ft. and at $M=0.74$ above that altitude. Descents are made, power off, at the M_{NO}/V_{NO} speed. For high-speed descents, at up to 8,000 ft./min., the undercarriage can be lowered, and holding patterns are flown at 190 knots with 30° flap.

Training Programme

T.W.A. trains its jet crews—and almost all its other flight and ground staff—at the Transportation Training Center, an eight-floor former furniture warehouse in down-town Kansas City. Flying training takes place from nearby Mid-Continent International Airport. The Training Center runs some 25 ground school courses, covering the requirements of all flight personnel, and such ground specialists as flight dispatchers, flight planning personnel, meteorologists, ticket agents, station personnel and transportation agents.

Preparations for jet training began some three years ago with some basic jet courses for instruction, followed by courses on the 707 two years ago. Towards the end of 1958 the task of training crews on the 707 began and is now a major programme at the centre. Jet crews are chosen on a seniority basis from volunteers among T.W.A.'s pool of 1,530 pilots, 683 flight engineers and 101 navigators. All captains qualified on the 707 so far have at least 20 years' service with the company, and have been flying Constellations and Starliners.

The company has no immediate requirement for new flight personnel; in fact, some pilots were placed on furlough two years ago and have still to be recalled. When needed, recruits, with military experience, can be obtained fairly easily—the requirements are 800 hours' solo (single-engined experience is sufficient) and an instrument rating. Pilots accepted for training receive a thorough ground course and experience in the air, and pass out as first officers after taking a line check. After five years as first officer they must qualify as captains or be discharged; once qualified, the T.W.A. first officer can expect to be appointed to a captaincy after another five years or so in the right-hand seat.

The 707 conversion course starts with three weeks of ground school, covering about 35 hours a week plus "homework." Then follows a week on the Link 707 simulator, including 12 hours' flying and 12 hours as observer in alternating two-hour spells. The minimum time in the 707 itself to

(*Continued on page 593*)

Among the dozen or so special training aids for the 707 at the Transportation Training Center is this $100,000 engine demonstrator, which includes a complete control panel and a sectioned model engine to show the results of every control movement.

VICTOR

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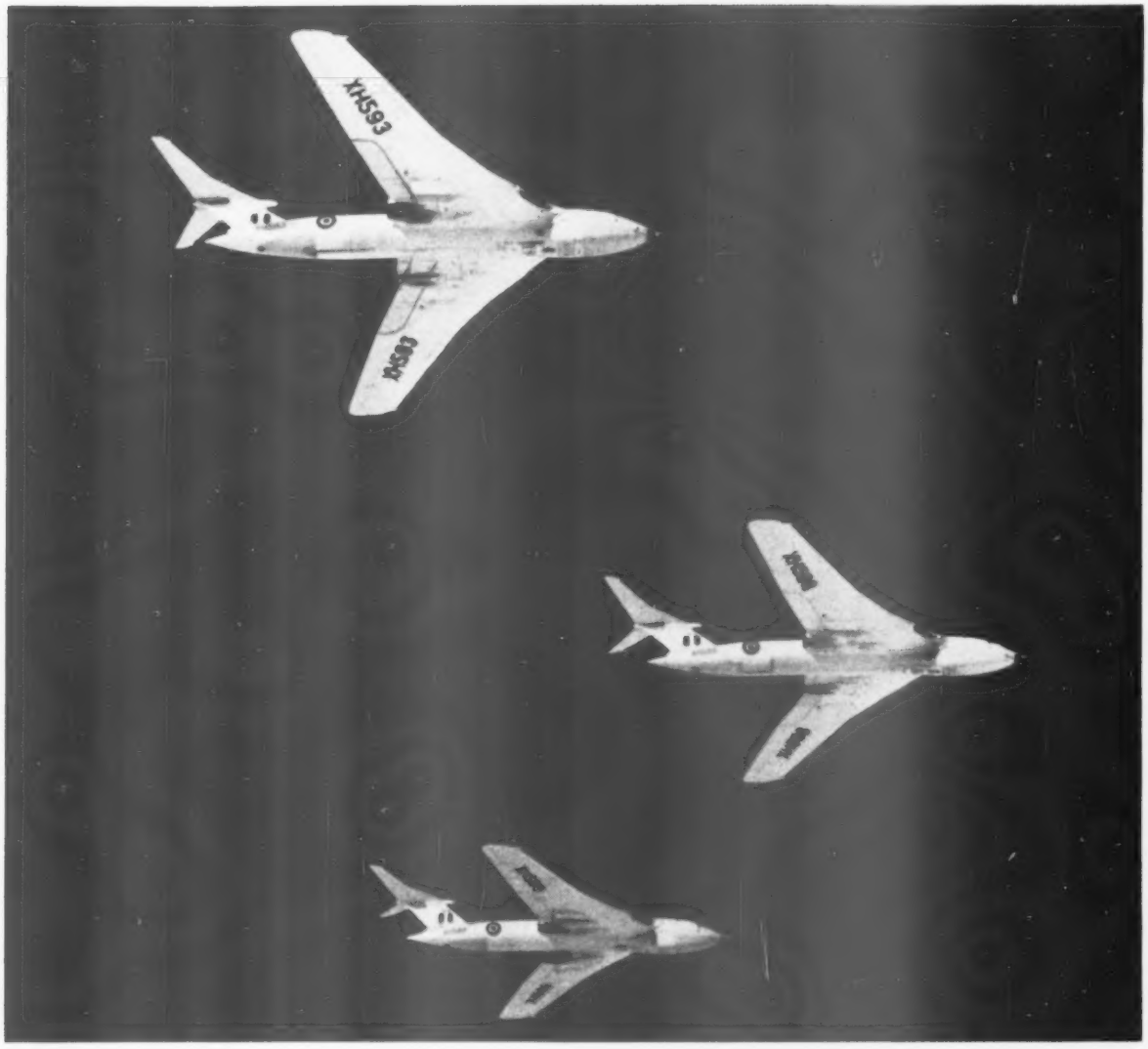

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(*Continued from page 592*)

complete the training schedule would be 10 hours, including the F.A.A. check. The average flight time taken in T.W.A. so far is 21 hours. Line training, with a supervisory captain, comprises a minimum of five domestic round trips, or two international round trips of four sectors each.

First and second officers receive similar training and in international operations take spells at each position. All pilots are given basic training on the flight engineer's panel.

The training programme on the moving-base simulator is divided into six sections with a total of 61 items covering cockpit familiarization, air work, take-off and landings (using the Link Mk. 4 visual system), radio navigation, emergency procedures and operation of the flight engineer's panel. The visual system is being used by T.W.A. for the first time and is of the closed-circuit television type, with a moving camera scanning a large-scale model of a typical runway and approaches. The picture is projected on to a screen in front of the cockpit, and any desired cloud break-out height can be simulated.

Most of the simulator programme is repeated in the air, but with more emphasis on handling the aircraft in unusual or emergency situations and less time on system emergencies.

A simulator for the Convair 880 will be installed alongside that for the Boeing 707 within the next week or two, and will be linked to the same visual system. Training programmes on the 880, of which T.W.A. has ordered 30, will be similar to those on the 707, and the crew arrangements and the cockpit layouts have been standardized so far as possible between the two types.

In addition to the conversion courses for crews going on to jets, the Training Centre handles courses for crews changing from one piston-engined type to another (e.g. Martin 404 to Constellation, Constellation to Starliner) and the 4-hr. semi-annual proficiency checks on emergency procedures which all flight personnel must take. A series of airport qualification films is being built up to familiarize pilots with strange airports. Each film, in colour, lasts 15-20 min. and shows the different approaches, in VMC, photographed from the co-pilot's seat. A year ago the C.A.A. confirmed an earlier provisional regulation permitting airport qualifications to be made solely on these films.

At peak periods the Training Center handles up to 250 pilots and flight engineers on conversion courses, apart from other staff categories. There are 22 ground school instructors, all highly qualified, and all of whom fly on the line or on training flights at least once a month. Flight instructors alternate between the simulator and the training aircraft and are all qualified on the line; many, in fact, instruct for the winter season and fly on the line during the peak summer months.

Overhaul Base

T.W.A. is understandably proud of its overhaul base at Mid-Continent International, an airport established by the Kansas City municipality some 14 miles north of the city and leased by T.W.A. At present, T.W.A. is the exclusive user of the 4,650-acre M.C.I.; all scheduled services use the Municipal Airport on the banks of the Missouri River, a mere 10 minutes' cab drive from the centre of Kansas City. If future traffic expansion demands, M.C.I. may be developed as the city's jet terminal, but, meantime, it perfectly meets T.W.A. jet-training needs. Its single 6,000-ft. runway is now in process of being extended to 9,000 ft. for the 707-331 Intercontinentals.

The overhaul base, built at a cost of $25 million, includes two massive airframe overhaul hangars, each measuring 816 ft. by 160 ft.; a 200,000-sq.-ft. powerplant overhaul building and a series of engine test cells using hydraulic dynamometers. At the time of our visit the first of T.W.A.'s Boeing 707-131s was in for its first major overhaul. F.A.A. approval has been obtained initially for 2,500 hours between overhaul, but this particular aircraft was pulled out of service at 2,300 hours, to avoid having several 707s on overhaul at once. The 10-day period allowed for this first overhaul is expected to be halved as experience on the 707 is increased.

About 40% of the work load on the major overhauls is concerned with routine items, the remainder comprising accumulated engineering changes and modifications, and work found necessary on inspection. Other maintenance checks on the 707 are the daily pre-flight or service check, station check A at 50 hours, station check B at 100 hours and a detailed inspection check C at 200 hours.

More important to the success of T.W.A.'s daily operations than the overhauls at M.C.I. is the organization which has been set up to maintain a constant and intimate control over maintenance functions throughout the T.W.A. system. The hub of this organization is the briefing room and the adjoining co-ordinators' office. In the former, a daily maintenance briefing session is held, in the presence of the vice-president, technical services, to study the previous day's operations, regularity, delays and incidents over the entire domestic network. Action taken on the spot to overcome non-routine snags is considered, and the lessons, if any, are noted for future reference.

Graphs and charts round the walls of the briefing room show how the fleets are performing, and break down the delays into various categories in order to highlight the areas where maximum effort is required.

For a well worth-while investment of some $12,000 a month, T.W.A. has established a private-line facility (PLF) by which M.C.I. is linked, by direct telephone lines through the co-ordinator's desk, to each major T.W.A. domestic terminal, where maintenance is looked after by specialist foremen. Through the PLF, these foremen can consult specialist engineers at M.C.I. or at the engineers' homes, which are also linked to the PLF. The PLF is also used for a countrywide briefing and joint consultation at least once a day with about 12 points linked simultaneously.

The co-ordinator, on duty 24 hours a day, also has before him a large display board in which the progress of every scheduled T.W.A. flight for the day is recorded. Various symbols are used to indicate delayed departures or arrivals, and special attention is given to repetitive difficulties—the same snag occurring three times in quick succession is the signal for urgent action to be taken.

The T.W.A. overhaul base and the maintenance organization were not set up specifically for jet operation; much of the present system was introduced, in fact, at the time the fleet of L-1649 Starliners came along. There is no doubt, however, that the company has derived tremendous benefits from the system so far as 707 operations are concerned and, although snags have naturally occurred, there have been few of a major nature. The daily briefing sessions have served to detect the likely problem areas and action has been taken in time to prevent trouble building up.—F.G.S.

The Air-freight Business

SCHEDULED North Atlantic freight ton-miles flown by IATA members increased by 18.5% last year by comparison with 1957 and the combined scheduled and non-scheduled ton-mile increase was 20.1%. In fact, the non-scheduled freight ton-miles increased by nearly 67%, but the figures for earlier years had been comparatively small and this jump did not, therefore, influence the overall increase by more than a point or two. The biggest Atlantic cargo ton-mile increase so far (44.4%) was that between 1955 and 1956.

There are, at present, five carriers offering scheduled all-freight capacity between North America and Europe, with a total of about 24 return services per week. In order of service frequency these carriers are Seaboard and Western, Pan American, K.L.M., T.W.A., and Swissair; three operate through London and the other two (K.L.M. and Swissair) call at Prestwick and Manchester.

T.W.A. is now taking a special interest in the expanding transcontinental and transatlantic all-freight business. With L-1049Hs, 15 services are operated weekly over three domestic routes and four services on two routes over the North Atlantic. T.W.A. is interested in the Canadair CL-44D and, for long-haul work, in the swing-tail Boeing 735. Since 707s are due to become the major ton-milers in the T.W.A. fleet, the 735 is of special interest, but there are many services on which the more flexible turboprop will be essential if major all-cargo re-equipment is planned.

In a recent newsletter Eagle Aviation offered interpretations of expressions in the air charter vocabulary—the idea being the useful one of ensuring that everyone in the business is speaking the same language. The strange-to-the-outsider words and their interpretations are:—

INDICATION: A rough estimate of the price for a charter, plus or minus 10% and with no undertaking that aircraft will be available for the date required.

QUOTATION: An exact estimate of price for a charter, usually given subject to an aircraft being available at the time of acceptance. If given with guarantee of availability a quotation becomes a firm offer.

FIRM OFFER: This is from a carrier to a charterer detailing price, aircraft availability and terms, or from a charterer to a carrier detailing his requirements and the price and terms he is prepared to accept. If the firm offer is acceptable to the other side (and is positively accepted by a certain time and date) then a fixture results.

FIXTURE: A booking committing both carrier and charterer to the flight in question.

The Fighting Services

Flag Officer Aircraft Carriers

REAR ADMIRAL R. M. SMEETON, M.B.E., is to become Flag Officer Aircraft Carriers in succession to Vice-Admiral C. L. G. Evans, C.B., C.B.E., D.S.O., D.S.C., on March 1, 1960.

Joining the staff of Flag Officer, Air (Home) as Commander, Flying Training, in June, 1946, Rear Admiral Smeeton was Commander (Air) in H.M.S. "Theseus" from June to November, 1947. Commander (Air) and Executive Officer of R.N.A.S. Lee-on-Solent from June, 1949, to March, 1950, he then became Deputy Director of Air Warfare (Materials) at the Admiralty. He took command of H.M.S. "Albion" in June, 1956, and on leaving the carrier has been Director of Plans at the Admiralty until June this year.

Second Britannia Squadron

NO. 511 Squadron, 1955 winners of the Berlin Air Lift Gold Cup, is to be re-formed at R.A.F. Lyneham on December 15 as the second Britannia squadron. To be commanded by Wg. Cdr. A. W. G. Le Hardy, O.B.E., the Squadron will form part of the strategic element of Transport Command.

Lyneham was the Squadron's base when it was first formed in 1942. Its regular mail service between the United Kingdom and the Near East was extended in October of that year to India, and services were later flown to Italy, North Africa and Karachi. Special flights were made in connection with the Casablanca, Cairo and Teheran Conferences. Later, flying Yorks, the Squadron operated on the Far East services until committed, in July, 1948, to "Operation Plainfare"—the Berlin Air Lift. Re-equipped with Hastings, it began operating passenger and freight services to Japan in August, 1949, and took part in many reinforcement operations, among them Korea, Kenya and Cyprus.

More recently the Squadron made special flights to Moscow, and operated the Warsaw service. In connection with "Operation Grapple" it made flights to Christmas Island, and ran a regular scheduled service to Woomera for the Ministry of Supply. In 1955 it supported No. 139 Squadron Canberras on a goodwill tour of Canada, the U.S.A. and the West Indies. The Squadron was disbanded in September of last year.

Pilot Interception Plotter

AN Air Council award of £100 has been made to Wg. Cdr. A. F. Wilson, D.F.C., serving in Denmark with the Allied Air Forces Northern Europe, for designing an interception plotter for use by day fighter pilots. Known as the Wilson Plotter, it has been adopted by Fighter Command and 2nd T.A.F., Germany, as a position pinpointing aid.

The plotter consists of a map board surmounted by two linked arms, each marked with a range scale and pivoted from two points on the map, which could represent DME or TACAN beacons, or CR/DF stations. Given his distance from these two points, a pilot can move the arms to form a point of intersection which indicates his position on the map. Described as an "ingenious and inexpensive boon to the fighter force," it is stated to have greatly contributed to fighter efficiency.

Third Mobility Exercise

REPRESENTING a further step in the series of air mobility trials undertaken this year by formations of the Strategic Reserve, last week's exercise "Winged Coachman" had similar aims to the October exercise "Red Banner" (THE AEROPLANE AND ASTRONAUTICS, October 23). These were to practice the mounting and air movement by Transport Command of an Infantry Brigade Group; to undertake tactical operations within 40 miles of the airhead; and the practice of a support maintenance organization from airhead to units in the field using helicopters and light fixed-wing aircraft.

Unlike the last exercise held on Salisbury Plain, which represented a limited war against a second-class enemy with some first-class equipment, "Winged Coachman" was more on the lines of an internal security operation against an enemy without any heavy equipment. Held in Northern Ireland, its air support force represented two of the three elements of Transport Command—tactical airlift and close support. The third element, strategic supply, was not properly tested in the exercise.

The first two elements, tactical airlift, represented by Beverleys of Nos. 47 and 53 Squadrons and Hastings of Nos. 24, 36 and 114 Squadrons, and close support, undertaken by Pioneers of No. 230 Squadron, will soon come under the control of No. 38 Group, the new formation to be established at R.A.F. Upavon in the New Year. The strategic element, which comprises mainly Britannias of Nos. 99 and 511 Squadrons and No. 216 Squadron Comets, backed-up for the time being by Hastings and Beverleys, will remain a second self-contained force.

A very much larger and, therefore, more realistic R.A.F./Army air mobility exercise is planned for next spring. For this, the complete Guards Brigade Group and part of the Headquarters of 3 Division will be flown out to North Africa in a strategic move. They will then be tactically airlifted to another airhead and go into action from there.

REDSKIN SHOWS.—This summer the Redskins aerobatic team from the Central Flying School, R.A.F. Little Rissington, gave 25 flying displays at various air meetings. The two-man team consists of Flt Lt. P. J. Hirst (right) and Flt. Lt. J. R. Rhind, who perform a 10-min. synchronized aerobatic display in red-and-white Jet Provost T Mk. 1s.

Appointments

THE following are among recent Royal Air Force appointments:—

Bomber Command: Gp. Capt. A. H. C. Boxer, D.S.O., D.F.C., to Headquarters for planning duties.

Coastal Command: Wg. Cdr. B. W. Parsons, A.F.C., to Headquarters as Wing Commander, Training.

Transport Command: Wg. Cdr. C. D. Burrill to Headquarters as Command Movements Officer.

Flying Training Command: Wg. Cdr. D. N. Fearon to R.A.F. Ternhill as Chief Instructor.

Technical Training Command: Wg. Cdr. D. M. B. Pitt, M.B.E., M.Sc., to the School of Technical Training, R.A.F. Halton, as Chief Education Officer, with the acting rank of Gp. Capt.

Middle East Air Force: Gp. Capt. D. F. Hyland-Smith, M.V.O., D.F.C., A.F.C., to Headquarters as Senior Personnel Staff Officer; Wg. Cdr. E. R. Bell, M.V.O., D.F.C., A.F.C., to R.A.F. El Adem, to command, with the acting rank of Gp. Capt.; Wg. Cdr. W. H. McCulloch to No. 24 R.A.F. Police District, Nicosia, as Assistant Provost Marshal; Wg. Cdr. J. L. Mitchell, M.V.O., D.F.C., A.F.C., to Headquarters for air staff duties.

Far East Air Force: Gp. Capt. P. A. Hughes, D.F.C., to R.A.F. Seletar to command; Wg. Cdr. R. N. G. Allen, D.F.C., to Headquarters No. 224 Group for administrative duties, with the acting rank of Gp. Capt.

R.A.F. Germany: Wg. Cdr. J. A. Ferguson to Headquarters Allied Air Forces Central Europe for air staff duties.

Other Appointments: Wg. Cdr. K. McK. Murray, D.F.C., to the United States for duties with N.A.T.O.

More Service News

Goodwill Visit.—Three Coastal Command Shackletons of No. 42 Squadron (Wg. Cdr. J. R. Ramsden) left R.A.F. St. Mawgan on December 1 for a 14-day visit to the Caribbean. Code named "Calypso Stream II," the visit is the second of a series of six-monthly training and liaison flights to the area.

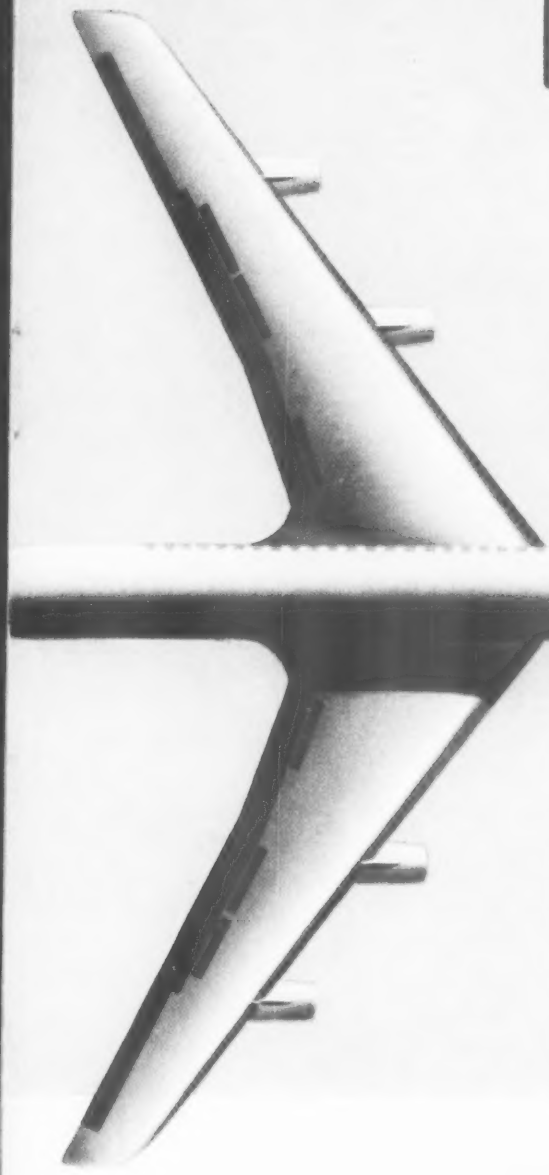
No. 122 Wing Reunion.—The Jever Steam Laundry shareholders annual general meeting will be held on Saturday, January 2, 1960, at Dirty Dick's, Liverpool Street, London, at 18.30 hrs. Details can be obtained from Flt. Lt. B. B. Sharman, Officers' Mess, R.A.F. Halton, Aylesbury, Bucks.

Queen's Colour Escort.—The R.A.F. Regiment Demonstration Flight, which on ceremonial occasions provides the Escort to The Queen's Colour for the R.A.F. Regiment, has been renamed the R.A.F. Regiment Colour Guard. Based at Catterick, its main task is providing field tactics demonstrations for new recruits.

THE AEROPLANE
and ASTRONAUTICS

Plessey

15 kW transformer rectifier unit



From a 200 volts three phase 320/500 cycle supply the unit gives up to 500 amps. d.c. at 28 volts for general aircraft services.

Two electrically displaced six-phase transformer circuits are paralleled to give an equivalent twelve-phase rectified output, with an inherent low ripple characteristic.

Good regulation and current sharing between rectifiers is achieved by connecting each rectifier to an individual transformer winding. The 36 silicon rectifiers are forced-air cooled and capable of a 40% overload for two minutes, without excessive temperature rise. Despite the power consumption of the blower, efficiency between light load and overload is not less than 91%.

Mounted on a substantial frame with removable cover for ease of access, the unit has been designed to meet all relevant specifications at altitudes up to 10,000 feet.

The complete unit weighs 54 lb. with a maximum height of 8 in., overall length including integrally mounted fan 24 in., and 9 in. width.

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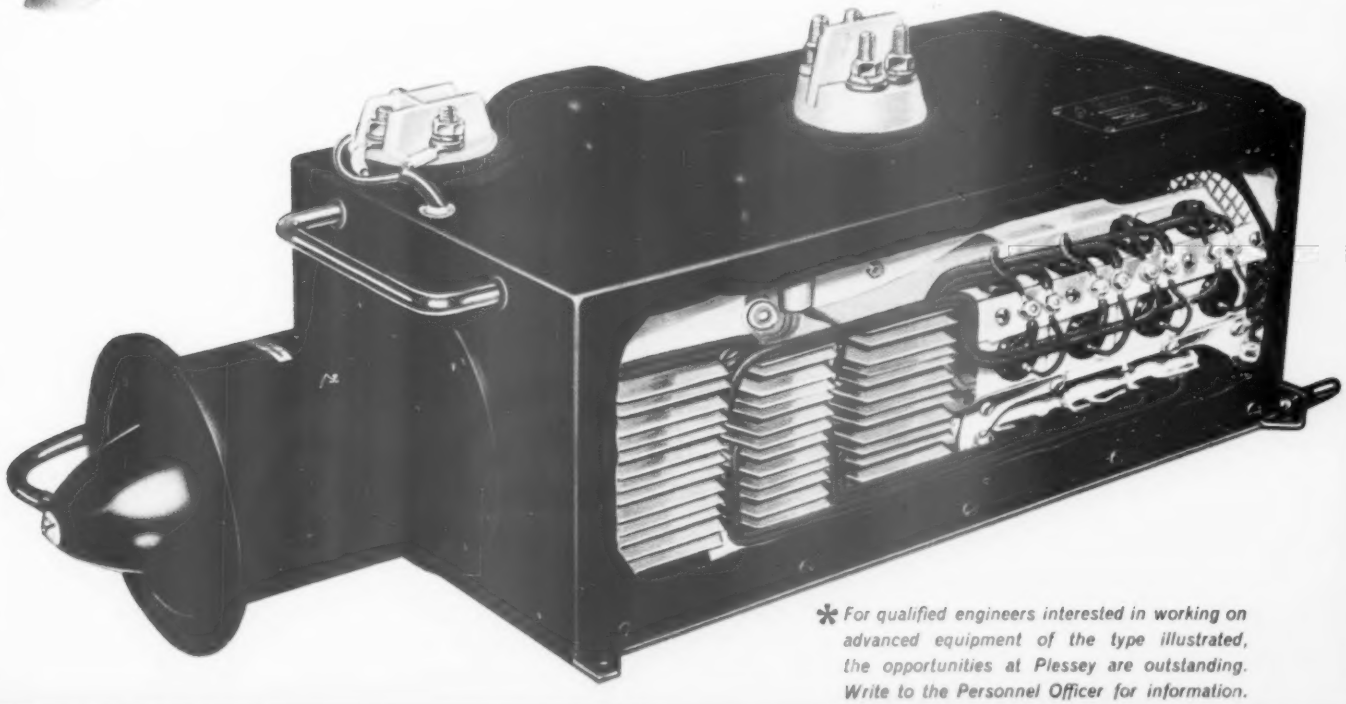

✻ *For qualified engineers interested in working on advanced equipment of the type illustrated, the opportunities at Plessey are outstanding. Write to the Personnel Officer for information.*

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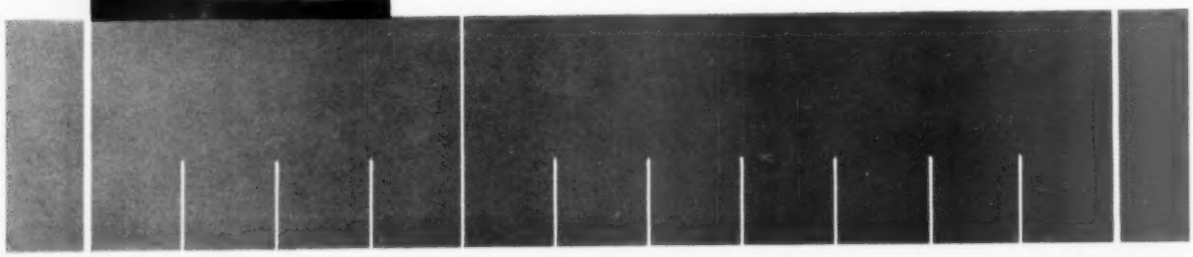

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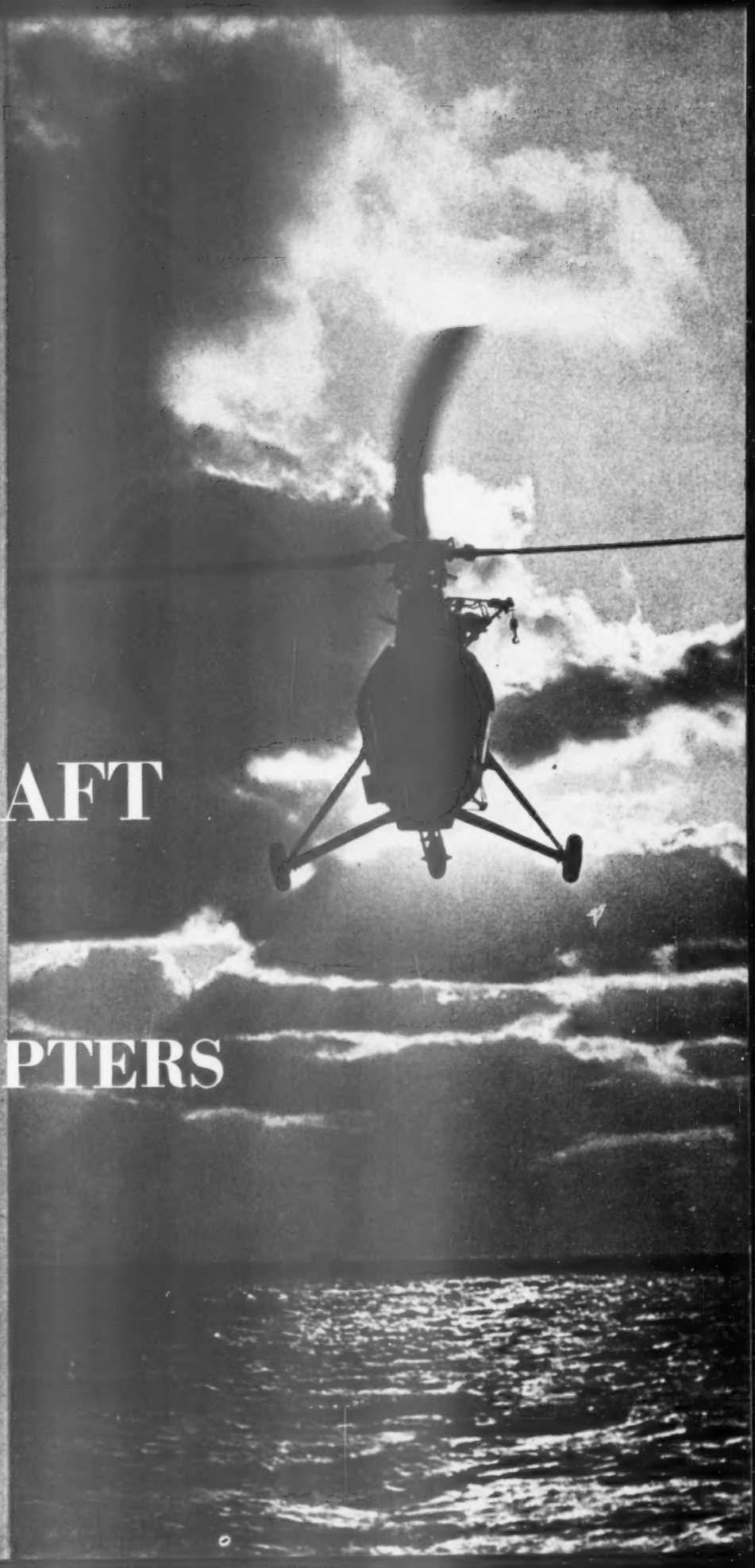
VTOL AIRCRAFT AND HELICOPTERS



In the following pages we present our annual survey of developments in VTOL, and rotary-wing, craft throughout the World. Also included is a special article reviewing American cushion-lift projects, known in the U.S.A. as "ground effect machines."

Helicopters and VTOL Craft in Britain

ALTHOUGH the past 12 months have not produced any far-reaching new developments among the actual products of Britain's rotary-wing industry they have at least seen two significant changes in the overall scene. For example, in July, there came an announcement of the acquisition by Westland Aircraft, Ltd., of the Saunders-Roe organization. And earlier in the year a conditional agreement was drawn up between the Royal Aeronautical Society and the Helicopter Association of Great Britain, whereby the Association would be dissolved and its funds and assets transferred to a new Rotorcraft section of the R.Ae.S.; this proposition was later accepted by members of the two bodies.

Undoubtedly the most notable technical event of the year was the first appearance in the summer of the remarkable Leonides-powered Saunders-Roe/N.R.D.C. Hovercraft. Although not strictly a rotary-wing craft, nor, indeed, a VTOL type, it aroused a great deal of interest at the S.B.A.C. Display. In a series of demonstrations it has clearly indicated its great potential as a Service and civil vehicle for operation over water or land. A study, elsewhere in this issue, of American projects in the same general category serves to emphasize the forward-thinking associated with this British project.

An important event of another sort was the official opening in April of Westland's London Heliport on the south bank of the Thames at Battersea. This noteworthy piece of private enterprise, although regarded by the company as no more than an experiment and by no means an answer to London's heliport problem, has proved to be even more successful than was originally envisaged. Indeed, in the first five months of its operation (which included the periods of the *Daily Mail* race and the S.B.A.C. Display) some 1,130 helicopter movements were made at the heliport.

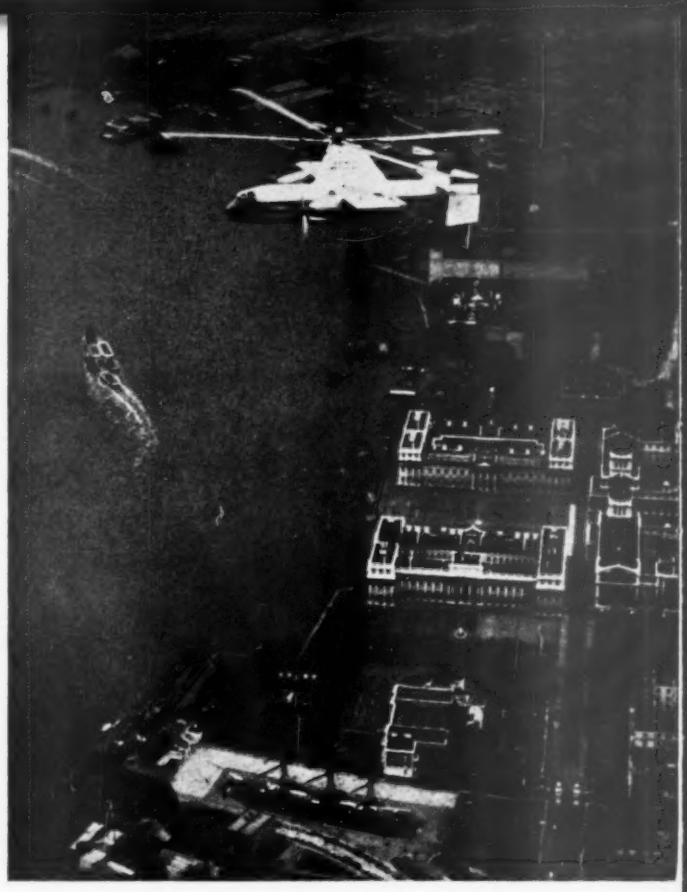
So far as the industry's manufacturing efforts during the year were concerned, these were particularly well illustrated by the large helicopter contribution at Farnborough. The current direction of effort was in fact seen to be towards a rational development of existing types.

For example, at Yeovil, Westland has completed an experimental installation of a de Havilland Gnome shaft-turbine engine in a Whirlwind. This will soon be followed by another, similar, installation involving the new Blackburn A.129 engine.

One of the Eland-powered Westminster prototypes was taken on a Continental tour after the Paris Aero Show and aroused a good deal of interest in Germany as a potential Service transport. Another important event at Yeovil has been the handing over of two Whirlwinds to the Queen's Flight.

Britain's large VTOL transport, the Eland-powered Fairey Rotodyne, has also been demonstrated on the Continent. At the present time work is proceeding on the larger production version with Rolls-Royce Tynes. But despite the welcome receipt of orders for one from Okanagan Airways and five from New York Airways and a Letter of Intent from B.E.A. for six, there has been no real clarification of the situation regarding the production future of this important project.

At Saunders-Roe, the second phase in the development of the P.531 was reached in the summer with the installation of the Blackburn A.129 in a third prototype. Saunders-Roe has also completed recently the first of a small batch of American Hiller Rotorcycles being built under contract to Helicop-Air of Paris.



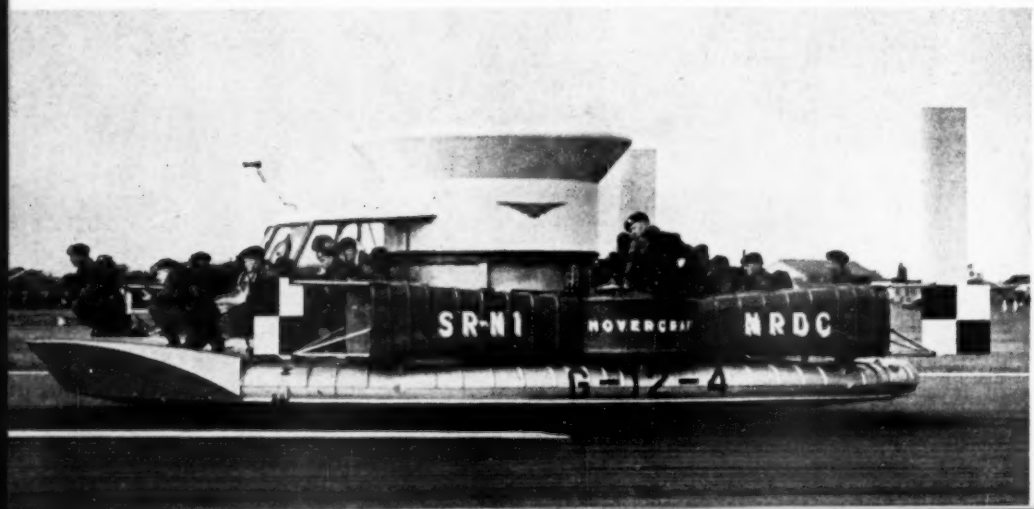
Fairey's Rotodyne prototype over the Thames at Greenwich.

Work at Bristol's Weston-super-Mare division during the year has primarily been concentrated on the Type 192 twin-engined tandem rotor helicopter for the R.A.F. production of which is well under way. It should enter service in 1960.

At present our only flat-rising VTOL craft, the Short SC.1 is still engaged in its development programme. Normal-flight and vertical-flight regimes have now been thoroughly explored and it remains for the transition phase to be covered. These trials are planned for the comparatively near future.

The flat-rising, fixed-wing type of VTOL aircraft would appear to have a most promising future, for civil as well as for military use. It can already claim an important place in the current development plans in this country for the Hawker company are actively engaged in the design of a strike aircraft with VTOL capability of this sort; and as a parallel development, Bristol Siddeley is producing a special powerplant.

Inevitably, Britain's helicopter and VTOL industry is small—at least by transatlantic standards. But what it lacks in size it makes up for in producing a comprehensive range of craft, details of which are given in the following two pages.



The Saunders-Roe/N.R.D.C. Hovercraft demonstrating its military potential at the S.B.A.C. Display, by carrying a party of Royal Marines.

Photograph copyright "The Aeroplane and Astronautics"

Britain's VTOL Aircraft . . . .

BRISTOL 171

OF the large number of Bristol 171 helicopters delivered, all but a few were built for military service. The Sycamore HR Mk.14 version is the principal aircraft used by the R.A.F. for rescue and general utility duties. Fifty Sycamore Mk. 52s have been supplied to the Federal German armed forces, three Mk. 14s to the Belgian Air Force and an unspecified number of Mks. 50 and 51 to the Royal Australian Navy. All versions except the prototypes have a 520-b.h.p. Alvis Leonides Mk. 173 (civil model 524/1) piston-engine and can carry up to four passengers, or a medical orderly and two stretcher patients, in addition to the pilot. Optional equipment includes a hydraulic winch and under-fuselage attachments for flying crane duties.

Dimensions.—Rotor dia., 48 ft. 7 in.; length (blades folded), 46 ft. 2 in.; height, 12 ft. 2 in.; disc area, 1,856 sq. ft.

Weights.—Normal take-off, 5,600 lb.; empty, 4,060–4,150 lb.; disc loading, 2.9 lb./sq. ft.

Performance.—Cruising speed, 91 – 107 m.p.h. at 2,000 ft.; inclined climb, 1,200 ft./min.; service ceiling, 14,500 ft.; normal range, 268 miles.

BRISTOL 192

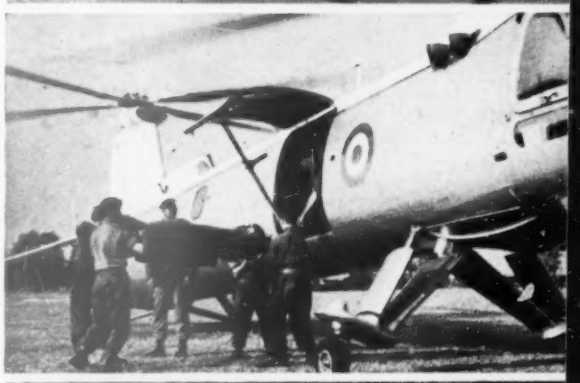
FIRST multi-engined helicopter of British design to enter production, the Type 192 Series 2 is powered by two Napier Gazelle 100 shaft-turbines, each developing 1,650 s.h.p. for 2½ min. and a normal continuous power of 920 s.h.p. This large reserve enables the aircraft to climb on one engine in an emergency.

The first of 30 for the R.A.F. flew on July 5, 1958, and has been followed by three more. Each will carry up to 25 fully equipped troops, up to 12 stretcher patients, 6,000 lb. of freight internally or 5,250 lb. in a flying-crane rôle. Maximum ferry range with auxiliary tankage is 715 miles. A civil version designated the Type 192C is projected, with the ability to carry 24 passengers at 140 m.p.h.

Dimensions.—Rotor dia., 48 ft. 8 in.; fuselage length, 54 ft. 4 in.; height, 17 ft.; disc area, each 1,860 sq. ft.

Weights.—Normal take-off, 18,000 lb.; empty, 10,913 lb.; disc loading, 4.84 lb./sq. ft.

Performance.—Cruising speed, 138 m.p.h.; inclined climb, 1,175 ft./min.; service ceiling, 13,250 ft.; normal range, 432 miles.



FAIREY ROTODYNE

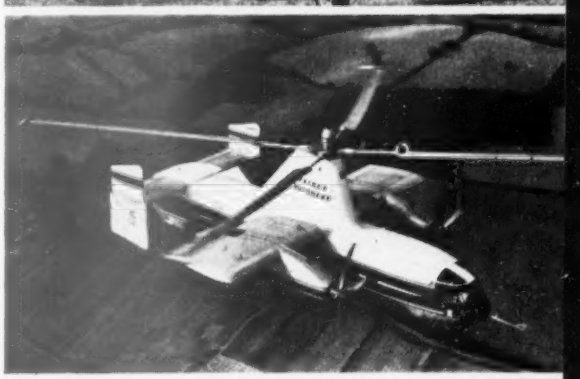
FASTEST rotorcraft in the World, the Rotodyne prototype, powered by two 3,000-e.h.p. Napier Eland turboprops and Fairey blade-tip pressure-jets, set up an international speed record of 191 m.p.h. over a 100-km. circuit on January 5, 1959. Production models will be larger, with two 5,000-s.h.p. Rolls-Royce Tyne turboprops and the ability to carry up to 70 passengers or 18,000 lb. of freight internally. Normal payload is expected to be 57 passengers on stages of at least 250 miles.

Present orders for the Tyne-powered version include five for New York Airways (plus option for 15) and one for Okanagan Helicopters. An order for six for B.E.A. is being negotiated and the Rotodyne is expected to be ordered also for the British Services. The following data apply to the production model :—

Dimensions.—Rotor dia., 104 ft.; fuselage length, 64 ft. 6 in.; wing span, 56 ft. 6 in.; height, 23 ft. 2 in.; disc area, 8,500 sq. ft.

Weights.—Normal take-off, 50,000 lb.; payload, 18,000 lb.; disc loading, 5.88 lb./sq. ft.

Performance.—Cruising speed, 201 m.p.h.; max. range, 650 miles.



SAUNDERS-ROE P.531

THE first two prototypes of the P.531 each had a 425-s.h.p. Blackburn-Turbomeca Turmo shaft-turbine, and a batch of three similar aircraft is being evaluated by the Royal Navy. Two further prototypes have also been built, with Blackburn A.129 and de Havilland Gnome shaft-turbines respectively, and extensive design changes, including a new rotor system and skids instead of the original wheel undercarriage. Production P.531 Mk. 2 aircraft will be to this standard, with a 968-s.h.p. A.129 Mk. 3 engine, having its output restricted to 650 s.h.p.

The version proposed for the Army will carry four passengers, or two stretcher patients and attendant, as well as the pilot. The Naval version will carry homing torpedoes for anti-submarine duties from frigates. The following data refer to the Mk. 2 :—

Dimensions.—Rotor dia., 32 ft. 3 in.; length (blades folded), 30 ft. 4 in.; height, 8 ft. 10 in.; disc area, 815 sq. ft.

Weights.—Normal take-off, 5,000 lb.; empty, 2,836 lb.; disc loading, 6.13 lb./sq. ft.

Performance.—Cruising speed, 115 m.p.h.; vertical climb, 180 ft./min.; normal range, 290 miles.

SAUNDERS-ROE SKEETER

ONE of the most manœuvrable light two-seat helicopters in the World, the Skeeter is in service with the British Army for A.O.P. and training duties. The original production versions were the A.O.P. Mk. 10 and T. Mk. 11 with a 200-h.p. D.H. Gipsy Major piston-engine. Current production models are the A.O.P. 12 and T. Mk. 13 with a 215-h.p. Gipsy Major, with optional water/methanol injection or turbo-supercharger. The comparable civil model is the Skeeter 8.

Eleven Skeeter Mk. 50s and 51s, generally similar to the A.O.P. Mk. 12, have been delivered to the Federal German Army and Navy respectively. Experimental installations of a Napier rotor-tip rocket system and of twin external stretcher-carriers have been made and flight tested. The following data apply to the A.O.P. Mk. 12 :—

Dimensions.—Rotor dia., 32 ft.; length (blades folded), 28 ft. 5 in.; height, 7 ft. 6 in.; disc area, 804 sq. ft.

Weights.—Normal take-off, 2,200 lb.; empty, 1,656 lb.; disc loading, 2.86 lb./sq. ft.

Performance.—Cruising speed, 101 m.p.h.; inclined climb, 1,150 ft./min.; service ceiling, 12,800 ft.; max. range, 213 miles.

Britain's VTOL Aircraft . . . .

WESTLAND WESSEX

INTENDED to supersede the Whirlwind HAS Mk. 7 as the Royal Navy's standard anti-submarine helicopter, the Wessex is basically a turbine-powered version of the Sikorsky S-58, retaining the latter's well-proven rotor system. The powerplant is a Napier Gazelle 160 shaft-turbine, giving 1,450 s.h.p. for one hour and a max. continuous power of 1,200 s.h.p.

A feature of major importance is that the Wessex HAS Mk. 1 will be a single-package anti-submarine aircraft, able to carry both dipping asdic search equipment and homing torpedoes. Needing no engine warm-up period, it can be sent into action very quickly, and the entire tail folds to facilitate stowage on board ship. Loads in alternative roles could include 12 passengers, eight stretchers or 4,000 lb. of freight internally or externally.

Dimensions.—Rotor dia., 56 ft.; overall length, 65 ft. 9½ in.; height, 15 ft. 10 in.; disc area, 2,460 sq. ft.

Weights.—Normal take-off, 12,600 lb.; empty (operational), 8,350 lb.; disc loading, 5.13 lb./sq. ft.

Performance.—Cruising speed, 115–127 m.p.h.; inclined climb, 1,750 ft./min.; ceiling (cruising), 14,000 ft.; range, 390–630 miles.

WESTLAND WESTMINSTER

THE two prototype Westminsters now flying have a simple steel-tube structure allied to the proven rotor system of the Sikorsky S-56 and the power of two 3,150-s.h.p. Napier Eland E.229A shaft-turbines. In this form they have demonstrated the flying-crane potential of the concept by hauling loads such as the 103-ft. long MEXE fully decked bridge.

Developed versions are projected in a wide range of configurations and with either two 3,500-s.h.p. Eland E.211 or two Rolls-Royce Tyne shaft-turbines. With the Elands, the standard utility flying-crane could haul a max. load of 14,000 lb. or five tons for 100 miles at 115 m.p.h. A refined version with an enclosed passenger cabin aft of the rotor and a stalky four-wheel undercarriage would carry a larger under-fuselage pod. The more conventional 40/50-seat passenger airliner, which exists in mock-up form, would cover 100-mile stages at 150 m.p.h. The following data apply to the prototypes:

Dimensions.—Rotor dia., 72 ft.; fuselage length, 69 ft.; height, 19 ft. 6 in.; disc area, 4,071 sq. ft.

Weights.—Normal take-off, 36,000 lb.; empty, 22,300 lb.; disc loading, 8.84 lb./sq. ft.

Performance.—Cruising speed, 115 m.p.h.; inclined climb, 1,900 ft./min.; hovering ceiling in ground effect, 9,000 ft.; ferry range, 1,150 miles.

WESTLAND WHIRLWIND

MANY civil and military versions of the Whirlwind have been built. The early marks were generally similar to the American-production Sikorsky S-55, but a switch was made to the more powerful 720-b.h.p. Alvis Leonides Major 155 piston-engine in the HAR Mk. 5 and this is now standard. After considerable development the Whirlwind HAS Mk. 7 is entering operational service as the Navy's standard anti-submarine helicopter. Two specially equipped HCC Mk. 8s of the Queen's Flight are similar except for cabin furnishings, with four to eight seats. The normal commercial Series 2 version carries 10–12 passengers, six stretchers or equivalent freight.

A prototype now flying with a D.H. Gnome shaft-turbine provides a considerably improved performance and will be offered for new production, with conversion kits available for Whirlwinds in service. The following data refer to this version which is illustrated:

Dimensions.—Rotor dia., 53 ft.; fuselage length, 44 ft. 2 in.; height, 13 ft. 3 in.; disc area, 2,206 sq. ft.

Weights.—Normal take-off, 8,000 lb.; empty, 4,761 lb.; disc loading, 3.63 lb./sq. ft.

Performance.—Cruising speed, 104 m.p.h.; inclined climb, 1,200 ft./min.; hovering ceiling in ground effect, 10,500 ft.; normal range, 275 miles.

WESTLAND WIDGEON

MARKED improvements in performance and comfort are offered by the five-seat Widgeon, developed from the original Sikorsky S-51 via the Westland Dragonfly. It has the same 500 b.h.p. Alvis Leonides piston-engine as the Dragonfly, the main changes being an enlarged cabin, with clamshell nose-door for stretcher-loading, and the fitting of a slightly modified Whirlwind four-blade rotor. Conversion kits are available for Dragonfly operators.

Conversion from passenger to ambulance role, with two stretchers and medical attendant, can be made in as little as four minutes. Optional equipment includes a hydraulic winch for rescue work, crop-spraying gear and amphibious pontoon landing gear.

Dimensions.—Rotor dia., 49 ft. 2 in.; fuselage length, 40 ft. 10 in.; height, 13 ft. 3 in.; disc area, 1,900 sq. ft.

Weights.—Normal take-off, 5,900 lb.; empty, 4,424 lb.; disc loading, 3.1 lb./sq. ft.

Performance.—Cruising speed 81 m.p.h.; inclined climb, 700 ft./min.; service ceiling, 10,500 ft.; max. range, 310 miles.

SHORT S.C.1

THIS delta-winged "flat-riser" was designed to carry a stage further the VTOL jet-lift technique pioneered by the Rolls-Royce "Flying Bedstead." Two pairs of 2,010-lb.s.t. Rolls-Royce RB.108 turbojets, mounted vertically in the fuselage, provide thrust for take-off and landing and can be tilted 30° fore and aft for acceleration and deceleration. Thrust for cruising flight is provided by a fifth RB.108 mounted normally in the tail. Air nozzles at nose, wingtips and tail provide stability control in hovering flight.

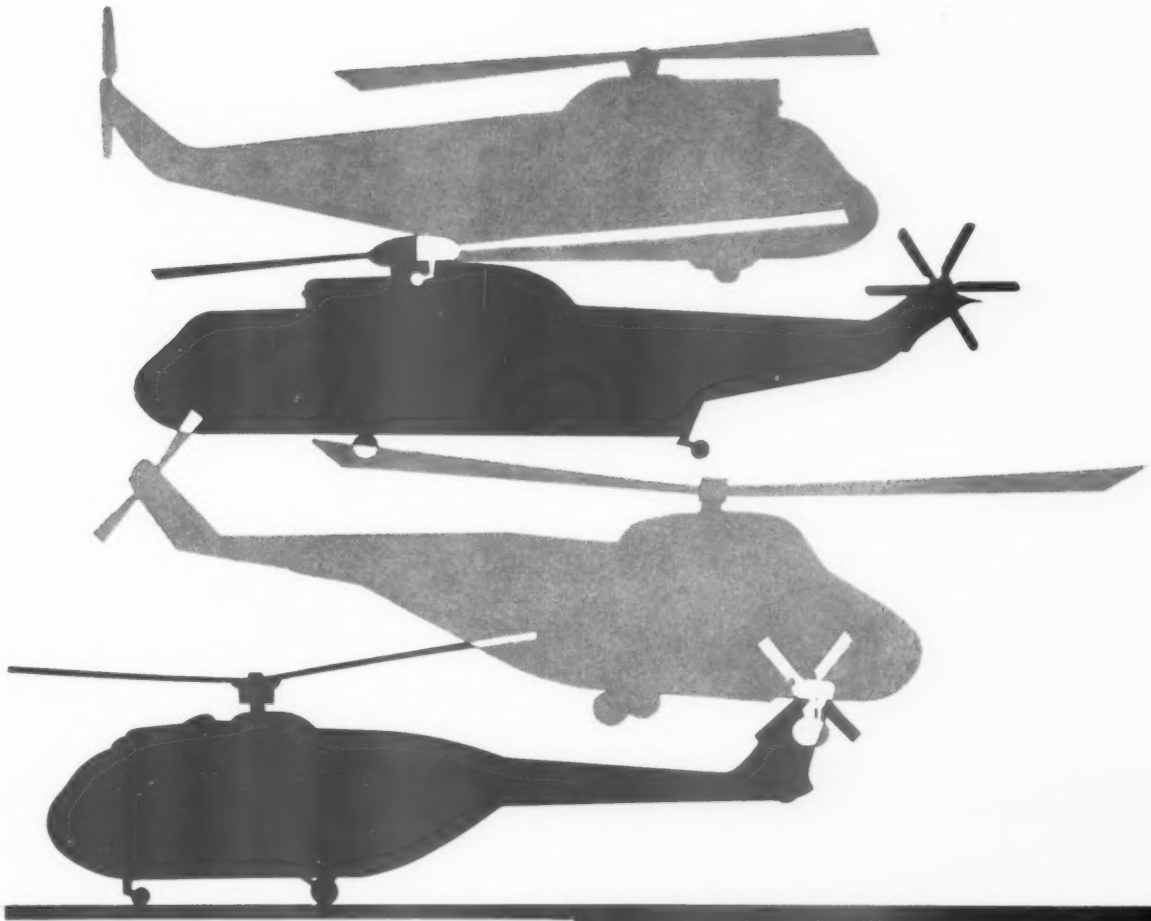
The first of two prototypes flew on April 2, 1957, after a conventional take-off run. The first free vertical take-off was made on October 25, 1958, and transition trials are now taking place at the R.A.E., Bedford.

Dimensions.—Span, 23 ft. 6 in.; length, 24 ft. 5 in.; height, 10 ft. 8 in.

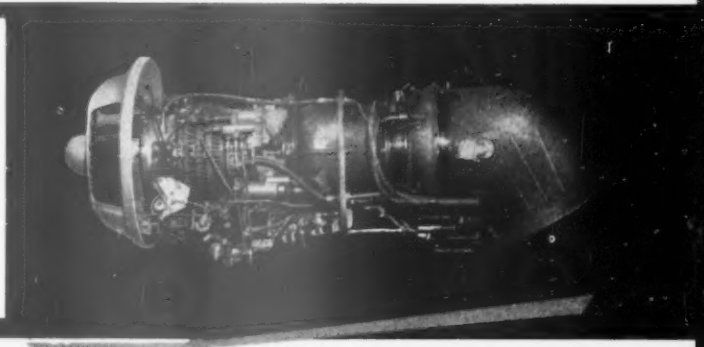
Weights.—Normal take-off, about 8,000 lb.

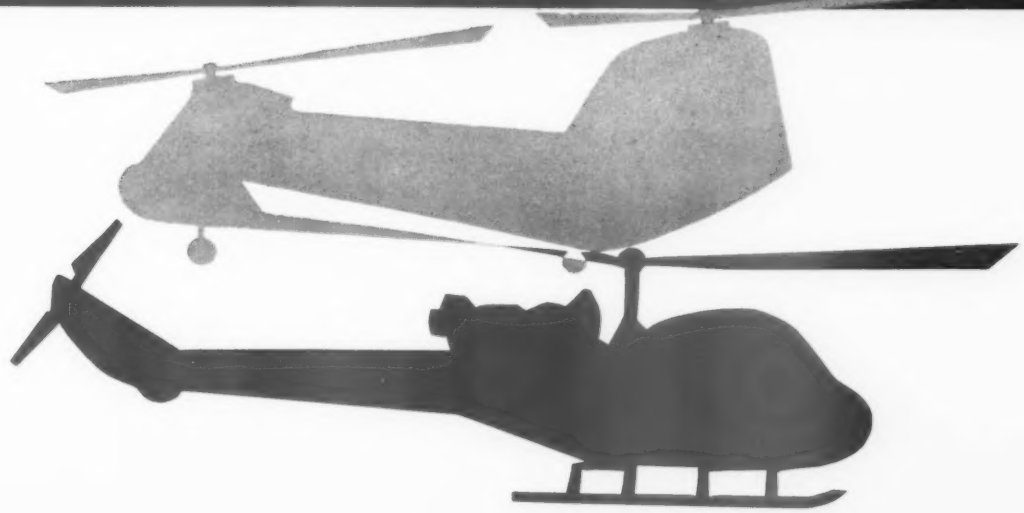
Performance.—Not available.

THE DE HAVILLAND ENGINE COMPANY LIMITED, LEAVESDEN, HERTFORDSHIRE, ENGLAND



The
Gnome
is in production for a number of helicopter applications





MILITARY MOBILITY

Bristol 192 helicopter demonstrates outstanding capability and versatility on Army exercise "Red Banner"

During the recent British Army exercise "Red Banner" held on Salisbury Plain, the Bristol 192 helicopter performed the role of tactical support vehicle with outstanding success.

In three consecutive sorties, the 192 carried (1) 10 men with full equipment plus 1,950-lb underslung freight; (2) transported 8 stretcher cases plus 2 sitting patients and (3) 4 stretcher cases plus 11 sitting patients.

Bristol 192, in quantity production now.

Backed by Bristol's 15 years of rotary-wing experience, the 192 is the first helicopter in quantity production with true twin-engine safety, and is due to go into RAF service in 1960. Powered by two Napier Gazelle NGa 2 free-turbine engines interconnected by a synchronising shaft, the 192 can hover on one engine at 95% of maximum gross weight.

The Bristol Sycamore, single-rotor helicopter has proved its efficiency in service and now has virtually no fixed retirement life on any of its components. The lessons learned from the Sycamore have been applied with great success to the Bristol 192.

BRISTOL 192 VERSATILITY

The most versatile army support vehicle ever produced, the Bristol 192 can act:—

As an aerial crane . . . carrying 6,640 lb slung beneath its fuselage.

As a transport . . . moving 18 fully armed men 200 miles, with ample fuel reserves.

As an assault craft . . . dropping 12 paratroopers (at 330 lb each) out to a radius of 120 miles from their base.

As an ambulance . . . with 12 stretcher cases plus 2 sitting patients and an attendant.

In all climates . . . the 192's performance in the tropics is unmatched by that of any other helicopter available now.

BRISTOL Aircraft

BRISTOL AIRCRAFT LIMITED

International VTOL Survey

On this and the following nine pages we give data and photographs for the principal rotary-wing and VTOL aircraft in production or undergoing active development throughout the World. The British products are on pages 597 and 598.

C.T.A. BEIJA-FLOR — Brazil

DESIGNED by Prof. Heinrich Focke, the Beija-Flor (Humming Bird) is the first product of the Centro Tecnico de Aeronautica which was set up by the Brazilian Air Ministry to foster the development of a stable aircraft industry in that country. It is a two-seat light helicopter, powered by a 225-b.h.p. Continental E225 piston-engine. This drives a three-blade main rotor and, as in Prof. Focke's subsequent design for the Borgward company, a twin tail rotor.

The Beija-Flor was first flown early in 1959 and has proved satisfactory despite the fact that the use of local materials where possible has resulted in a fairly heavy airframe. Future prototypes are expected to remedy this.

Dimensions.—Rotor dia., 29 ft. 6 in.; fuselage length, 27 ft. 8 in.; height, 10 ft. 4 in.

Weight.—Normal take-off, 2,095 lb.

Performance.—Cruising speed, 81–87 m.p.h.; inclined climb, 1,215 ft./min.; service ceiling, 11,500 ft.; normal range, 170 miles.

AVIAN 2/180 GYROPLANE — Canada

A SURPRISE development in rotary-wing flight has been the revival of the autogyro in several countries in the past year. From Canada has come the Avian Gyroplane, designed and built by a number of former Avro Aircraft engineers, who hope to begin deliveries of fully certificated production models by the spring of next year. Powerplant is a 180-b.h.p. Lycoming piston-engine, driving a ducted pusher propeller at the tail. The all-steel rotor is unpowered in cruising flight, but jump-starts are made possible by a unique tip-drive technique, using compressed air from a glass-fibre bottle that is charged automatically during forward flight. The cabin seats two in tandem.

Dimensions.—Rotor dia., 26 ft.; overall length, 14 ft. 7 in.; height, 7 ft. 11 in.; disc area, 531 sq. ft.

Weights.—Normal take-off, 1,600 lb.; empty 1,000 lb.; disc loading, 3.01 lb./sq. ft.

Performance (estimated).—Cruising speed, 150 m.p.h.; inclined climb, 1,500 ft./min.; normal range, 450 miles.

OMNIPOL HC-2 HELI-BABY — Czechoslovakia

ALTHOUGH it was reported early in 1958 that an initial production series of 200 HC-2s was to be laid down for domestic use and export, little has been heard of this ultra-light two-seater during the past twelve months. The prototypes, to which the data given below apply, are powered by an 83-b.h.p. Praga DH flat-four piston-engine, but the 105-b.h.p. four-cylinder M110 is said to be under development for the production machines. The HC-2 is intended for the full range of light helicopter applications, and there is sufficient space behind the cabin for it to be used as a single-seat light cargo and mail carrier.

Dimensions.—Rotor dia., 28 ft. 10 in.; overall length, 34 ft. 4 in.; height, 8 ft. 4 in.; disc area, 653 sq. ft.

Weights.—Normal take-off, 1,280 lb.; empty, 838 lb.; disc loading, 1.96 lb./sq. ft.

Performance.—Cruising speed, 62 m.p.h.; inclined climb, 705 ft./min.; service ceiling, 9,940 ft.; range, 93 miles.

HELICOP-AIR GIRHEL — France

ONE of the surprises of the 1959 Paris *Salon*, the Girhel is a side-by-side two-seat light autogyro, to which wings are fitted to provide the major part of the lift required for cruising flight and so offload the rotor. Two versions are offered, of which the Girhel L50 has a 90-b.h.p. Continental C90 piston-engine and the Girhel L51 a 150-b.h.p. Lycoming 0-320. A clutch and engine drive-shaft permit pre-rotation of the rotor for jump-starts. Dual controls are optional and there is space for baggage aft of the seats, with provision for carrying a stretcher or crop-spraying gear. The following data apply to the Girhel L50:

Dimensions.—Rotor dia., 32 ft. 9½ in.; span, 19 ft. 8 in.; length, 20 ft.; height, 8 ft. 10 in.; disc area, 845.5 sq. ft.

Weights.—Normal take-off, 1,380 lb.; empty, 838 lb.; disc loading, 1.63 lb./sq. ft.

Performance (estimated).—Cruising speed, 87 m.p.h.; min. flying speed, 18 m.p.h.; normal range, 310 miles.

SUD-AVIATION S.E.3130 ALOUETTE II — France

ONE of the major successes of the French aircraft industry in recent years, the five-seat Alouette II is in series production in France and is being assembled by Republic in the U.S.A. and Saab in Sweden, both companies being licensed for eventual manufacture of the type. When the last figures were released in September, 474 had been ordered from Sud-Aviation, made up of 240 for the French armed services and 234 for foreign military and commercial operators in 17 countries. The Alouette has a 400-s.h.p. Turboméca Artouste II shaft-turbine and is adaptable for the full range of helicopter applications, optional equipment including agricultural spray-gear, external stretcher-carriers and rails for six Nord S.S.11 wire-guided anti-tank missiles.

Dimensions.—Rotor dia., 33 ft. 6 in.; length (blades folded), 31 ft. 6 in.; height, 9 ft.; disc area, 880 sq. ft.

Weights.—Normal take-off, 3,300 lb.; empty, 1,875 lb.; disc loading, 3.75 lb./sq. ft.

Performance.—Cruising speed, 106 m.p.h.; inclined climb, 880 ft./min.; service ceiling, 10,500 ft.; range, 330 miles.

International VTOL

SUD-AVIATION S.E.3160 ALOUETTE III — France

THIS seven-seat helicopter has been developed from the Alouette II via the experimental S.E.3140 with Turmo II shaft-turbine, the S.E.3150 with Artouste III and the Gouverneur, which was the first version with a fully skinned structure. Powered by a 700-s.h.p. Turboméca Artouste IIIB shaft-turbine, it flew for the first time on February 28, 1959, and is scheduled for quantity production in 1961. In the commercial version, large baggage holds are provided in the centre-fuselage. The ambulance version carries pilot, two stretchers and two seated persons. The passenger seats can be removed for freighting, and in the military role the doors can be left off to permit the transport of eight fully equipped troops, seated on the floor facing outward. Optional equipment includes under-fuselage cargo hook, pontoons and winch.

Dimensions.—Rotor dia., 36 ft. 1 in.; length (blades folded), 33 ft.; height, 9 ft. 8 in.; disc area, 1,022 sq. ft.

Weights.—Normal take-off, 4,190 lb.; empty, 2,300 lb.; disc loading, 4.10 lb./sq. ft.

Performance.—Cruising speed, 115 m.p.h.; service ceiling, 13,100 ft.; range, max. payload, 155 miles.

SUD-AVIATION S.E.3200 FRELON — France

FIRST of the new generation of three-engined intermediate-size transport helicopters, the Frelon flew on June 10, 1959, with 750-s.h.p. Turboméca Turmo IIIB shaft-turbines. These will be replaced by 1,000/1,100-s.h.p. Turmo IIICs in production machines. All fuel is in external tanks. Designed for all-weather operations, the Frelon will carry 24 passengers for 62 miles, two tons of internal or external freight for 185 miles, or 15 stretchers and two attendants for 250 miles. One of the prototypes was shown at this year's Paris *Salon* with four Nord S.S.11 anti-tank missiles under the nose, and an anti-submarine search-strike version is projected. The tail hinges for freight loading and shipboard stowage.

Dimensions.—Rotor dia., 49 ft. 2¼ in.; length (blades folded), 48 ft. 10¾ in.; height, 15 ft. 5 in.; disc area, 1,902 sq. ft.

Weights.—Normal take-off, 16,530 lb.; empty, 9,920 lb.; disc loading, 8.69 lb./sq. ft.

Performance.—Ferry range, 800 miles.

SUD-AVIATION S.O.1221 DJINN — France

THE two-seat Djinn was the first helicopter to feature a "cold-jet" rotor system, with propulsion by compressed air ejected from blade-tip nozzles, without any form of combustion. The air is supplied by a Turboméca Palouste IV air-generator, mounted aft of the cabin. Orders announced to date are for five prototypes, of which the first flew on December 16, 1953, 22 pre-production and 150 production aircraft. Most of these have been delivered and many are in service with the French Army for observation and liaison duties, and for casualty evacuation carrying two external stretchers. Nord S.S.10 wire-guided missiles can be carried on rails on each side of the cabin.

Dimensions.—Rotor dia., 36 ft. 1 in.; fuselage length, 17 ft. 4 in.; height, 8 ft. 5 in.; disc area, 1,022 sq. ft.

Weights.—Normal take-off, 1,765 lb.; empty, 795 lb.; disc loading, 1.73 lb./sq. ft.

Performance (at 1,540 lb. a.u.w.).—Cruising speed, 66 m.p.h.; inclined climb, 690 ft./min.; hovering ceiling in ground effect, 5,900 ft.; range, 118 miles.

BÖLKOW Bö-103 — West Germany

THIS ultra-light single-seater began life as the Bö-102 Heli-Trainer, mounted on a pivoted steel tube or pontoon base and capable of everything but flying. It proved so successful that Bölkow have now taken the airframe off the base, fitted it with skids and, with only detail changes, have turned it into a light flying trainer. The powerplant is a 40/50-b.h.p. ILO three-cylinder two-stroke engine, driving a single-blade glass-bonded plastics rotor, with counterweight and paddle-type stabilizing bar. Developed versions, with engines of up to 85 b.h.p., are projected for a wider range of applications.

Dimensions.—Rotor dia., 21 ft. 7 in.; disc area, 366.5 sq. ft.

Weights.—Normal take-off, 882 lb.; disc loading, 2.41 lb./sq. ft.

Performance (estimated).—Cruising speed, 71 m.p.h.; range, 280 miles.

BORGWARD KOLIBRI I — West Germany

DESIGNED by Prof. E. H. Focke, this three-seat general-purpose helicopter was flown for the first time on July 8, 1958, by Ewald Rohlfs, who set up several international helicopter records in the pioneer Focke-Wulf Fw 61 before the War. It is powered by a 260-b.h.p. Lycoming VO-435-A1B flat-six piston-engine and features a similar Vee twin-tail-rotor layout to that of the Brazilian Beija-Flor by the same designer. In this case, however, the engine is in the centre-section, not the fuselage nose. Provision is made for carrying one internal and one external stretcher in the ambulance role, up to 660 lb. of freight on an under-fuselage attachment, or agricultural equipment.

Dimensions.—Rotor dia., 30 ft. 10 in.; fuselage length, 27 ft. 3 in.; height, 10 ft.; disc area, 753 sq. ft.

Weights.—Normal take-off, 2,645 lb.; empty, 1,765 lb.; disc loading, 3.51 lb./sq. ft.

Performance.—Cruising speed, 87 m.p.h.; inclined climb, 790 ft./min.; ceiling, 14,750 ft.; range, 250 miles.

AGUSTA-BELL MODEL 102 — Italy

IN addition to manufacturing the Bell Model 47 under licence, Agusta are developing a series of helicopters of their own design. First to fly, on February 3, 1959, was the Model 102 which is reminiscent of the Bell Model 42 of 1946. Powered by a 600-b.h.p. Pratt & Whitney R-1340 piston-engine, it can carry a pilot and up to nine passengers, equivalent freight or four stretcher patients and attendant. A Bell-type rotor system is used. Other Agusta designs are the single-seat Model 103 with 80-b.h.p. Agusta G.A.70 piston-engine, and the 27-passenger Model AZ101G, powered by three D.H. Gnome shaft-turbines, which is due to fly soon.

Dimensions.—Rotor dia., 47 ft. 7 in.; fuselage length, 41 ft. 9 in.; height, 10 ft. 7 in.; disc area, 1,780 sq. ft.

Weights.—Normal take-off, 6,217 lb.; empty, 3,990 lb.; disc loading, 3.49 lb./sq. ft.

Performance.—Cruising speed, 100 m.p.h.; inclined climb, 1,100 ft./min.; service ceiling, 14,000 ft.; range, 295 miles.

Survey . . . .

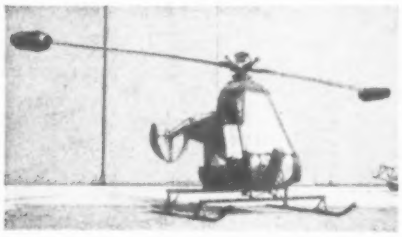
LUALDI L.59 — Italy

THE L.59 is the production version of Aer Lualdi's four-seat light helicopter, the development of which began with the ES.53 of 1953. A feature of the design from the start has been a combination of the well-proven Hiller Rotor-Matic rotor system with a Lualdi gyroscopic device which is said to give unusually good handling characteristics. The ES.53 had an 85-b.h.p. Continental engine. This was replaced by a 180-b.h.p. Lycoming O-360 in the L.55 (illustrated), which introduced a streamlined fuselage structure. The rotor diameters were increased in the L.57, which also had an auto-pilot, and the L.59 is similar to this version except for a more powerful 260-b.h.p. Continental IO-470-D engine and metal instead of plastics rotor-blades.

Dimensions.—Rotor dia., 34 ft. 9½ in.; fuselage length, 29 ft. 9½ in.; height, 9 ft. 8 in.; disc area, 951 sq. ft.

Weights.—Normal take-off, 2,557 lb.; empty, 1,475 lb.; disc loading, 2.69 lb./sq. ft.

Performance (estimated).—Cruising speed, 86 m.p.h.; inclined climb, 820 ft./min.; absolute ceiling, 19,350 ft.; endurance, 3½ hr.



HAGIWARA JHX-4 — Japan

DEVELOPMENT of a single-seat ultra-light helicopter with pulse-jet tip-drive was started by Mr. Hisao Hagiwara in 1952. The engines proved excessively noisy and difficult to ignite, so a switch to ramjet power was made in 1955. Since then three prototypes have been built, of which the JHX-4, first flown in September 1958, is the latest. Few details are available, beyond what can be deduced from illustrations of the aircraft undergoing its flight trials. These show that it has a two-blade main rotor, a small tail rotor, conventional controls and a tubular skid undercarriage.

Dimensions.—Rotor dia., 23 ft. 11 in.; length, 12 ft. 6 in.; height, 7 ft. 2½ in.; disc area, 452 sq. ft.

Weights.—Not available.

Performance.—Endurance, 30 min.

NHI H-3 KOLIBRIE — Netherlands

FIRST ramjet-powered helicopter licensed for commercial use, the Kolibrie is a highly manoeuvrable and stable two-seater, with a simple "self-adjusting" two-blade rotor. This features a see-saw hinge, and the blades are connected by a pack of leaf springs in place of the usual torsion bearings and flapping hinges. Each ramjet weighs 20 lb., gives 44 lb.s.t. and is attached to the blade-tip by two bolts, the fuel supply and ignition being connected automatically on assembly. Optional equipment includes two stretchers, agricultural gear, under-fuselage freight-hook, pontoons and "swamp-boards." Production is managed by Aviolanda, with rotor heads and ramjets produced by Kromhout and rotor blades by Fokker.

Dimensions.—Rotor dia., 33 ft.; fuselage length, 13 ft. 10½ in.; height, 8 ft. 6 in.; disc area, 852.2 sq. ft.

Weights.—Normal take-off, 1,435 lb.; empty, 600 lb.; disc loading, 1.84 lb./sq. ft.

Performance.—Cruising speed, 56 m.p.h.; inclined climb, 800–1,600 ft./min.; range (pilot only), 43 miles.

KAMOV Ka-15 — Soviet Union

POWERED by a 255-b.h.p. Ivchenko AI-14V engine, the two-seat Ka-15 has a co-axial rotor system of the kind that has become a feature of all the designs of Nikolai Kamov. First seen in 1955, it is in service with both the Soviet armed forces and Aeroflot, who use it for mail and charter flying, crop-spraying, operation from ice-breakers, some kinds of sonar work and, in its Ka-15M version, as an ambulance with two external stretcher containers. On May 6, 1959, V. Vinitskii set up a 500-km. helicopter speed record of 105.9 m.p.h. in the 1,000-1,750 kg. class to supersede the 100-km. record of 101.15 m.p.h. which he had held in the Ka-15 since May 1958.

Dimensions.—Rotor dia., 32 ft. 8½ in.; disc area, 840 sq. ft.

Weights.—Normal take-off, 2,805 lb.; disc loading, 3.34 lb./sq. ft.

Performance.—Cruising speed, 78 m.p.h.; service ceiling, 9,840 ft.; normal range, 195 miles.

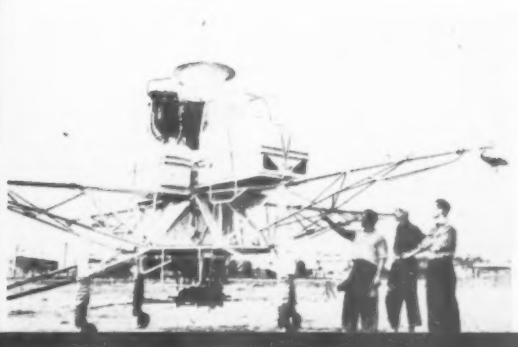
KAMOV Ka-18 — Soviet Union

THE Ka-18 utilizes the Ka-15's power-plant and rotor system, with foam-plastic-filled wooden blades, but has a redesigned and larger cabin seating four persons in two pairs. It is used by Aeroflot for a variety of duties, including passenger, freight and mail carrying and geographic survey. The agricultural version has two external chemical containers and spray bars. In the ambulance version, stretchers can be loaded into the cabin through a special hinged nose-door. Long-range tanks can be fitted to increase the Ka-18's range to 435 miles.

Dimensions.—Rotor dia., 32 ft. 8½ in.; fuselage length, 23 ft.; height, 10 ft. 10 in.; disc area, 840 sq. ft.

Weights.—Normal take-off, 2,890 lb.; empty, 2,255 lb.; disc loading, 3.44 lb./sq. ft.

Performance.—Cruising speed, 68 m.p.h.; normal range, 108–155 miles.



MATVEYEV TURBOLET — Soviet Union

FIRST announced in October 1957, Russia's "Flying Bedstead" is stated to be but one of several jet-lift projects, including airliners, under development in that country. It was designed by a team comprising Messrs. Rafaelantz, Kvashnin and Lapshin, under the leadership of Prof. Matveyev. The Turbolet consists basically of a steel-tube framework, built around a vertically mounted axial-flow turbojet, which is possibly a Mikulin RD-3 of 14,850-20,950 lb.s.t. Fuel tanks are mounted on each side of the engine, and there are differential compressed-air nozzles on the ends of the four long booms to provide control and stability. The interior of the control cabin has been described as resembling that of a MiG-17 fighter. The span across the ends of the booms appears to be about 30 ft.

No dimensions, weights or performance figures have been released officially.

International VTOL Survey . . . .

MIL Mi-1 AND Mi-3 — Soviet Union

FIRST helicopter to enter large-scale production in the Soviet Union, the four-seat Mi-1 was first flown in 1950 and has been in civil and military service since 1951. Standard powerplant is the 575-b.h.p. Ivchenko AI-26V piston-engine, although versions have been reported with a 540-b.h.p. M-61 and a new shaft-turbine which is said to save over 650 lb. on the empty weight. Variants are the three-seat Mi-1T, the Mi-1U dual-control trainer and the Mi-1NKh with provision for stretcher panniers, mail containers, insecticide hoppers or fuel tanks on the fuselage sides. Polish-built versions are designated SM-1 and SM-1Z. The Mi-3, flown in 1956, is similar to the Mi-1NKh, but with four-blade rotor, wider fuselage and other changes. Data refer to the Mi-1.

Dimensions.—Rotor dia., 46 ft. 8 in.; length, 39 ft. 9 in.; height, 10 ft. 10 in.; disc area, 1,710 sq. ft.

Weights.—Normal take-off, 4,960 lb.; empty, 3,925 lb.; disc loading, 2.90 lb./sq. ft.

Performance.—Cruising speed, 87 m.p.h.; inclined climb, 1,280 ft./min.; service ceiling, 14,760 ft.; range, 220–310 miles.

MIL Mi-4 — Soviet Union

RUSSIA'S counterpart to the Sikorsky S-58, the Mi-4, appeared in 1952 and is now the most widely used Soviet helicopter, in both civil and military service. Standard powerplant is the 1,750-b.h.p. Shvetsov ASh-82V, although the designer has referred to an 18-passenger turbine-powered version. Accommodation in the military Mi-4 is for 14 fully equipped troops or 3,520 lb. freight, including vehicles and guns which are loaded through rear clam-shell doors. Additional cargo space is provided in the under-fuselage pannier. Aeroflot has the 10-passenger Mi-4P and the Mi-4S agricultural spray-plane. A fire-fighting version has a controllable hose in the ventral pannier.

Dimensions.—Rotor dia., 68 ft. 11 in.; fuselage length, 55 ft. 1 in.; height, 17 ft.; disc area, 3,710 sq. ft.

Weights.—Normal take-off, 15,875 lb.; disc loading, 4.28 lb./sq. ft.

Performance.—Cruising speed, 93 m.p.h.; service ceiling, 16,000 ft.; range, 300 miles.

MIL Mi-6 — Soviet Union

ANNOUNCED in the autumn of 1957, the Mi-6 is the largest and heaviest helicopter yet flown anywhere in the World, with normal seating for 70–80 passengers and rear clam-shell loading doors for vehicles and freight. Its designer, Mikhail Mil, has stated that it will enter service during 1960. The Mi-6 has two 4,635-e.h.p. Soloviev TB-2BM shaft-turbines, driving a five-blade main rotor. Small wings are fitted to off-load the rotor in cruising flight and Mil claims that an aerodynamic breakthrough has made possible a max. speed of 217 m.p.h. Already the prototype holds several helicopter records, including a speed of 167.206 m.p.h. over a 100-km. circuit, and climbs to 20,800 ft. with an 11,023-lb. payload, to 18,536 ft. with a 22,046-lb. payload, and to more than 6,560 ft. with 26,464 lb. The C.G. travel is reported to be 18 in.

Dimensions.—Rotor dia., 114 ft. 10 in.; length, 108 ft.; disc area, 10,388 sq. ft.

Weights.—Normal take-off, 71,000 lb.; empty, approx. 45,000 lb.; disc loading, 6.83 lb./sq. ft.

Performance.—Not available.

YAKOVLEV Yak-24 — Soviet Union

LARGEST helicopter in operational service, the Yak-24 enjoyed from the start the advantages of utilizing two well-proven Mi-4 powerplant/rotor systems. It has been standard equipment in the Soviet armed forces since 1955, and has demonstrated its ability to carry up to 40 troops, internal loads such as a truck and field gun or two GAZ-69 command vehicles, and under-fuselage loads that have included a five-ton truck. The loading ramp at the rear of the cabin is power-operated. To permit operation of the Yak-24 as a 40-passenger short-haul airliner, the rotor diameter is to be increased by 10 ft. to 79 ft. and the fuselage extended. The original Vee tail has already given way to a twin-fin arrangement and the entire fuselage is now metal-covered, instead of just the nose and tail.

Dimensions.—Rotor dia. (each) 68 ft. 11 in.; fuselage length, 92 ft.; height, 23 ft.; disc area (each), 3,710 sq. ft.

Weights.—Normal take-off, 28,000 lb.; disc loading, 3.77 lb./sq. ft.

Performance.—Cruising speed, 117–127 m.p.h.; service ceiling, 18,000 ft.; range, 300 miles.

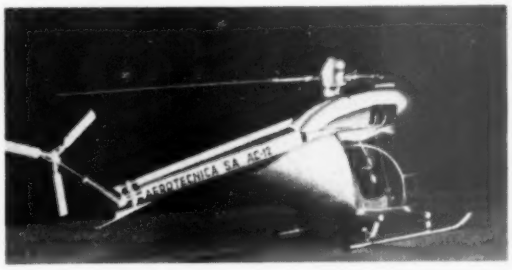
AEROTECNICA AC-12 — Spain

DESIGNED by the French engineer Jean Cantinieau, the AC-12 two-seat light helicopter is a development of his original MC-101 prototype, which was built in France by the Matra company. As in the MC-101, the 168-b.h.p. Lycoming O-360-B2A fan-cooled engine is mounted above the cabin. It drives a three-blade rotor, with double-articulated blades, through a transmission and reduction gear system that has been designed and manufactured by the ENHASA airscrew company. The first of two prototypes of the AC-12, built for Aerotecnica by the A.I.S.A. company, flew on July 20, 1956. A production series of 12 has since been ordered by the Spanish Government.

Dimensions.—Rotor dia., 27 ft. 10 in.; fuselage length, 24 ft. 1 in.; height, 9 ft.; disc area, 613.3 sq. ft.

Weights.—Normal take-off, 1,700 lb.; empty, 1,080 lb.; disc loading, 2.77 lb./sq. ft.

Performance.—Cruising speed, 68 m.p.h.; inclined climb, 845 ft./min.; service ceiling, 10,200 ft.; range, 105 miles.



AEROTECNICA AC-14 — Spain

FIRST flown on July 16, 1957, the AC-14 is virtually a scaled-up development of the AC-12, with seats for a pilot and four passengers. It is turbine-powered by a 400-s.h.p. Turboméca Artouste IIB, which is mounted above the cabin and drives a four-blade rotor with double-articulated blades. Anti-torque control is achieved by deflecting the efflux from the engine during vertical and low-speed flight. In cruising flight the residual thrust is used to increase forward speed, and directional control is then provided by the two small vertical rudders. Six AC-14s are being built by ENHASA.

Dimensions.—Rotor dia., 31 ft. 6 in.; fuselage length, 27 ft. 1 in.; height, 10 ft. 2 in.; disc area, 778.8 sq. ft.

Weights.—Normal take-off, 2,865 lb.; empty, 1,545 lb.; disc loading, 3.68 lb./sq. ft.

Performance.—Cruising speed, 93 m.p.h.; inclined climb, 985 ft./min.; service ceiling, 20,830 ft.; range, 162 miles.

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The P.531 is designed to meet the demand for a compact, turbine powered, general purpose helicopter. Good performance and carrying capacity, versatility and ease of servicing are features of this functional aircraft. The P.531 is on order for the Ministry of Aviation for the Royal Navy.

The P.531 illustrated above is powered by the Blackburn A.129 engine.

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ADAMS-WILSON XH-1 HOBBYCOPTER U.S.A.

ONE of the first helicopters designed from the start for construction at home by amateurs, the HobbyCopter is an ultra-light single-seater powered by a 40-b.h.p. Triumph 650 c.c. motorcycle engine. It has a simple bolted aluminium-tube structure and tubular skid undercarriage. The drive from engine to gearbox is by chain; from the gearbox the solid spruce two-blade main rotor is shaft-driven and the aluminium two-blade tail rotor is belt-driven. The XH-1 has a glass-fibre seat and conventional helicopter controls. The prototype HobbyCopter, built by T. G. Adams and Paul Wilson, flew in November 1958. More than 100 sets of plans and kits have since been sold.

Dimensions.—Rotor dia., 21 ft. 6 in.; fuselage length, 14 ft.; height, 6 ft.; disc area, 363.2 sq. ft.

Weights.—Normal take-off, 555 lb.; empty, 355 lb.; disc loading, 1.53 lb./sq. ft.

Performance.—Cruising speed, 40–45 m.p.h.; service ceiling, 8,000 ft.; range, 55–120 miles.

BELL HU-1A IROQUOIS U.S.A.

THIS turbine-powered military helicopter combines extreme manœuvrability with high performance and a planned minimum overhaul life of 1,000 hr. The first of three XH-40 prototypes flew on October 22, 1956, and was followed by six YH-40 Service test aircraft. The first of nine pre-production HU-1As was delivered to the U.S. Army on June 30, 1959, and the initial series of 100 production models will begin to enter service in the spring. Powered by an 860-s.h.p. (de-rated to 700-s.h.p.) Lycoming T53-L-1 shaft-turbine, these aircraft will carry a pilot and five passengers, stretchers, or 3,000 lb. of internal or external freight. An experimental installation of six Nord S.S.11 wire-guided anti-tank missiles is under test, and Bell have a contract to fit the 960-s.h.p. T53-L-5 in four existing airframes.

Dimensions.—Rotor dia., 44 ft.; fuselage length, 39 ft. 7½ in.; height, 14 ft. 7 in.; disc area, 1,520 sq. ft.

Weights.—Normal take-off, 5,800 lb.; empty, 3,834 lb.; disc loading, 3.8 lb./sq. ft.

Performance.—Cruising speed, 115 m.p.h.; inclined climb, 2,100 ft./min.; hovering ceiling in ground effect, 14,400 ft.; range over 210 miles.

BELL MODEL 47G U.S.A.

EXACTLY two years ago today, Bell delivered the 2,000th Model 47, and this little utility three-seater not only continues in production but is still undergoing development. Now coming off the line are the Model 47G-2 Trooper, with a 260-b.h.p. Lycoming VO-435 engine (de-rated to 200-b.h.p. to enable maximum power to be maintained to 5,000 ft.) and its military counterpart, the H-13H Sioux, of which over 400 are being built for the U.S. Army. Deliveries of the new Model 47G-3, with a Franklin 6VS-335 turbo-supercharged engine, giving 225 b.h.p. from sea level to 15,000 ft., and a Model 47J rotor system, will begin next spring. All versions can be fitted with dual controls, stretcher carriers, cargo-hooks, spray-gear, pontoons, etc. The following data apply to the new 47G-3:—

Dimensions.—Rotor dia., 37 ft. 3 in.; fuselage length approx., 28 ft. 6 in.; disc area, 1,087 sq. ft.

Weights.—Normal take-off, 2,550 lb.; empty, 1,539 lb.; disc loading, 2.35 lb./sq. ft.

Performance.—Max. cruising speed, 105 m.p.h.; service ceiling over 23,000 ft.; max. range, 236 miles.

BELL MODEL 47J RANGER U.S.A.

THIS "streamlined" development of the Model 47G has a lengthened cabin, accommodating a pilot in front and three passengers on a bench seat at the rear, with utility or *de luxe* furnishing. The passenger seat can be folded back to make room for cargo, or removed to permit the transport of two stretchers and a jump-seat for a medical attendant. Variants include two V.I.P. H-13Js for Presidential use; the HUL-1, a standard 47J for utility duties and ice-breaker patrol with the U.S. Navy; two HUL-1Cs for Coast Guard patrol; two experimental HUL-2s with 250-s.h.p. Allison YT63-A-3 shaft-turbine; and 18 HTL-7 basic and instrument flying trainers for the Navy. All except the HUL-2 have a 260-b.h.p. Lycoming VO-435 engine, de-rated to 240-b.h.p.

Dimensions.—Rotor dia., 37 ft. 2 in.; fuselage length, 32 ft. 4½ in.; height, 9 ft. 4 in.; disc area, 1,085 sq. ft.

Weights.—Normal take-off, 2,800 lb.; empty, 1,618 lb.; disc loading, 2.58 lb./sq. ft.

Performance.—Cruising speed, 100 m.p.h.; service ceiling, 17,000 ft.; normal range, 200 miles.

BELL XV-3 U.S.A.

AN important milestone in the development of the XV-3 tilting-rotor convertiplane was reached on December 18 last year, when it made its first full conversion from vertical to horizontal flight and *vice versa*. Tests have since continued under a follow-on contract, and many more conversions have been made, by several different civilian and Service pilots. The XV-3 is powered by a Pratt & Whitney R-985 piston-engine, which drives wingtip-mounted two-blade semi-rigid rotor/propellers. These function as helicopter rotors during take-off and are tilted forward through 90° to operate as propellers in cruising flight, when the fixed wings provide all necessary lift. Conversion takes 10-15 sec. A recent modification has been the addition of a ventral fin.

Dimensions.—Rotor dia., 25 ft.; span of wings, 30 ft.; fuselage length, 30 ft.; height, 13 ft. 6 in.; disc area (total), 982 sq. ft.

Weights and Performance.—Not available.

BENSEN B-8M GYRO-COPTER U.S.A.

SEVERAL Gyro-Copter autogyros have now been built by amateurs in the U.K., in addition to many flying in the U.S.A. and elsewhere. The B-8M is a single-seater, powered by a 72-b.h.p. McCulloch 4318E four-cylinder two-stroke engine, which drives a pusher propeller. A mechanical drive-shaft can be engaged to accelerate the rotor to flying speed on the ground; then, by transferring the power to the propeller, it is possible to take off in 50 ft. The B-7M Gyro-Copter is similar but with a lower-powered Nelson or Triumph engine and no rotor drive. Bensen are currently marketing kits and plans of both versions, as well as of the unpowered B-8 Gyro-Glider rotor craft and its variants, the Hydro-Glider and Gyro-Boat, with floats and dinghy hull respectively. Data are for B-8M:—

Dimensions.—Rotor dia., 20 ft.; fuselage length, 11 ft. 4 in.; height, 6 ft. 3 in.; disc area, 314 sq. ft.

Weights.—Normal take-off, 500 lb.; empty, 247 lb.; disc loading, 1.6 lb./sq. ft.

Performance.—Cruising speed, 60 m.p.h.; inclined climb, 2,000 ft./min.; service ceiling, 16,500 ft.; range, 100–300 miles.

International VTOL Survey . . . .

BENSEN B-9 LITTLE ZIPSTER — U.S.A.

CLAIMED to be the World's smallest helicopter designed especially for private and commercial use, the B-9 is the first true helicopter produced by Bensen. Like the company's other designs, it is available as a finished product or in the form of a kit of parts or plans for amateur construction. The B-9 is a single-seater, powered by a 60-b.h.p. Mercury outboard engine, which drives two contra-rotating co-axial rotors. A simple tilting head replaces the usual swashplate, and the pilot's controls comprise a fore-and-aft moving overhead stick, rudder pedals and twist-grip throttle. The transmission is designed for an overhaul life of 2,000 hr.

Dimensions.—Rotor dia. (each), 20 ft.; disc area, 314 sq. ft.

Weights.—Normal take-off, 700 lb.; disc loading, 2.23 lb./sq. ft.

Performance.—Cruising speed, 60 m.p.h.; range, 100 miles.

BRANTLY B-2 — U.S.A.

UNDER the designation YHO-3BR, three B-2s are currently being evaluated by the U.S. Army at Fort Rucker, Alabama, and two by the U.S. Navy at Patuxent River, Maryland. Others have been delivered to civilian customers. Future production may be centred in the U.K., following the formation of Brantly Helicopters, Ltd., at Swansea, to whom a B-2 is being supplied for demonstration and study. The B-2 is a dual-control two-seater, powered by a 180-b.h.p. Lycoming VO-360 A1A flat-four piston-engine. This drives an unconventional three-blade main rotor, which has articulated inboard flapping hinges near the hub and coincident flap and lag hinges at approx. 40% of the blade span.

Dimensions.—Rotor dia., 23 ft. 9 in.; length, 21 ft. 9 in.; height, 6 ft. 11¾ in.; disc area, 442 sq. ft.

Weights.—Normal take-off, 1,600 lb.; empty, 980 lb.; disc loading, 3.62 lb./sq. ft.

Performance.—Cruising speed, 100 m.p.h.; inclined climb, 1,500 ft./min.; hovering ceiling in ground effect, 4,700 ft.; range, 300 miles.

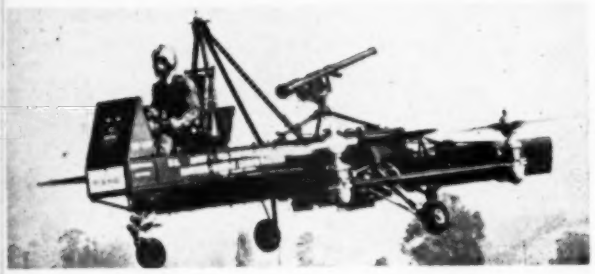
CESSNA CH-1C — U.S.A.

MECHANICAL and aerodynamic changes which are claimed to provide complete static and dynamic stability, plus increased fuel tankage, distinguish the latest four-seat Cessna CH-1C from the "B" model, of which 10 were delivered to the U.S. Army under the designation of YH-41 Seneca. Features of the earlier model which are retained are the nose-mounted 270-b.h.p. Continental FSO-526-A engine and the method of blade attachment to the main rotor hub through flexible L-section sheet-steel hinges, which permit continuously varying pitch without the use of pitch-change bearings. Only three gears are used in the main transmission and two in the tail rotor assembly.

Dimensions.—Rotor dia., 35 ft.; fuselage length, 32 ft. 8 in.; height, 7 ft. 1¾ in.; disc area, 960 sq. ft.

Weights.—Normal take-off, 3,100 lb.; empty, 2,050 lb.; disc loading, 3.22 lb./sq. ft.

Performance.—Cruising speed, 100–120 m.p.h.; inclined climb, 950 ft./min.; hovering ceiling in ground effect, 10,000 ft.; range, 400 miles.



CURTISS-WRIGHT VZ-7AP — U.S.A.

DEVELOPED by the Santa Barbara Division of Curtiss-Wright (formerly the Aerophysics Development Corpn.), the VZ-7AP "flying platform" is one of three direct-lift VTOL research vehicles which will be evaluated by the U.S. Army Transportation Corps. It differs from the others in having four two-blade rotors, driven by a single 425-s.h.p. Turboméca Artouste IIB shaft-turbine. The pilot's controls (aided by a stability augmentor) consist of a conventional collective-pitch lever for climb and descent, a control column which changes the rotor pitch differentially for control in pitch and roll, and pedals to operate a rudder in the jet efflux. In addition to the pilot, other personnel or weapons can be carried on the flat platform between the rotors.

Dimensions (approx.).—Width, 16 ft.; length, 17 ft.

Weights (approx.).—Normal take-off, 1,700 lb.; useful load, 555 lb.

Performance.—Not available.

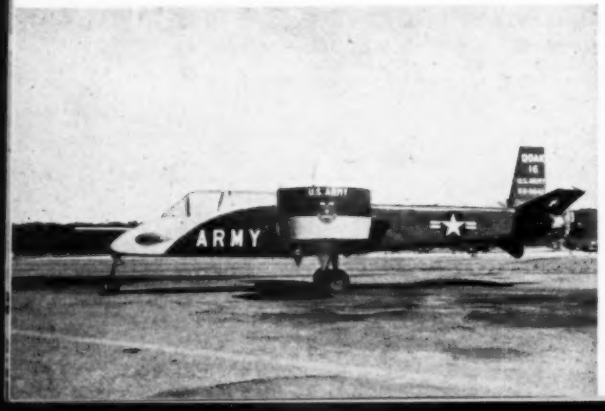
DE LACKNER AEROCYCLE — U.S.A.

THIS pioneer design for a platform type of "flying motorcycle" has undergone considerable experimental development in the past year. In its original form, the pilot changed course by leaning in the direction in which he wanted to travel; but at least two of the prototype Aerocycles have now been fitted with movable elevators at the end of a tail-boom attached to the platform. Only controls are handle-bars for turning the vehicle to face the direction of travel and a twist-grip throttle. The Aerocycle has a 40-b.h.p. Kiekhaefer Mercury 55 two-stroke outboard motor, mounted above a pair of chain-driven contra-rotating rotors. Two U.S. gal. of fuel are carried in the hollow control column. Skids or a pontoon undercarriage can be fitted.

Dimensions.—Rotor dia., 15 ft.; disc area, 177 sq. ft.

Weight.—Normal take-off approx., 500 lb.

Performance (estimated).—Cruising speed, 75 m.p.h.; range, 50 miles.



DOAK VZ-4DA — U.S.A.

THIS unique convertiplane has two wingtip-mounted ducted propellers driven by an 825-s.h.p. Lycoming T53 shaft-turbine, which is in the fuselage behind tandem seats for the crew of two. For vertical take-off the ducts are turned to a vertical position, and are then tilted through 90° in the air to provide forward propulsion for cruising flight. During conversion and vertical flight control is achieved by the use of small cruciform vanes working in the jet efflux. When vertical take-off is not necessary, larger payloads can be carried by operating the VZ-4DA as a conventional fixed-wing or STOL aircraft, with the ducts in cruising or intermediate attitudes respectively. Tests at Edwards Air Force Base have proved outstandingly successful, promising well for future observation, liaison and casualty evacuation aircraft utilizing the tilting-duct concept.

Dimensions.—Span over ducts, 25 ft. 6 in.; length, 32 ft.; height, 10 ft.

Weights.—Normal take-off, 3,000 lb.; empty, 2,300 lb.

Performance.—Not available.

the STOL Caribou

The sand strip at Fort Benning Georgia (left) is 1,100 feet long. The photo was taken from the cockpit of the Caribou as the aircraft was about to touch down.

With a gentle 5-knot headwind, the Caribou came to rest 150 feet short of the dark spot in the middle foreground. ***By actual measurement —in less than 300 feet!***

ISOLATION lost much of its more hapless shades of meaning when the first Caribou took off at Downsview, Ontario, on July 30th, 1958.

Now any community with a field or dirt strip large enough to accommodate a light airplane is a potential port of call for the 13-ton, 30-passenger STOL Caribou.

The Caribou
Designed and built by

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DOWNSVIEW ONTARIO

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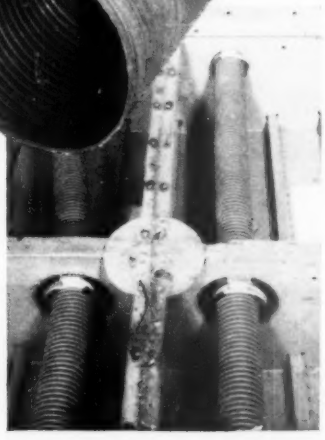

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DOMAN LZ-5 U.S.A.

FIRST flown on April 27, 1953, and certificated for commercial use on December 30, 1955, the Doman LZ-5 is a general-utility helicopter with normal accommodation for a crew of two and up to six passengers. With the passenger seats removed it can carry four stretchers or freight, and bulky objects can be loaded easily by detaching the accordian-type doors, which gives a 7-ft. 1-in. wide access to the cabin. With the fuselage covering and other non-structural components removed, the LZ-5 becomes a flying crane or agricultural aircraft with a disposable load of 2,250 lb. instead of the normal 1,950 lb. The LZ-5 has a 400-b.h.p. Lycoming SO-580-A1B piston-engine, driving a four-blade hingeless main rotor on a gimbal-mounted hub.

Dimensions.—Rotor dia., 48 ft.; fuselage length, 37 ft. 10 in.; height, 10 ft. 5 in.; disc area, 1,810 sq. ft.

Weights.—Normal take-off, 5,200 lb.; normal empty, 3,250 lb.; disc loading, 2.87 lb./sq. ft.

Performance.—Cruising speed, 82 m.p.h.; inclined climb, 1,190 ft./min.; service ceiling, 12,000 ft.; range, 380 miles.

GOODYEAR GA-400R-3 GIZMO U.S.A.

ALTHOUGH the GA-400R-3 has been demonstrated to various U.S. military agencies, it remains entirely a private venture. Its structure comprises an extremely simple tubular frame, and it is powered by a 38-b.h.p. Johnson 35 two-stroke engine, which drives the two-blade main and tail rotors through a belt and pulley system. The pilot sits on an open seat at the front, with conventional helicopter controls. Since it made its first flight on May 9, 1954, the GA-400R-3 has undergone considerable development and is now offered as a military liaison or tactical vehicle for any duty that requires the transport of one man at up to 70 m.p.h.

Dimensions.—Rotor dia., 20 ft.; length, 21 ft.; height, 7 ft.; disc area, 314 sq. ft.

Weights.—Normal take-off, 490 lb.; disc loading, 1.56 lb./sq. ft.

Performance.—Cruising speed, 50 m.p.h.; inclined climb, 500 ft./min.; service ceiling, 12,000 ft.; range, 50 miles.

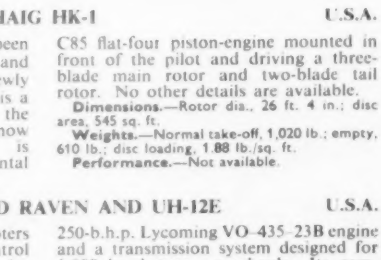
GYRODYNE XRON-1 ROTORCYCLE U.S.A.

ALTOGETHER 13 of these one-man ultra-light helicopters have been built to date for company and military testing, which has included 25 hours' flying at the U.S. Navy's Patuxent River Test Center. The 44-b.h.p. Nelson engines fitted originally have been replaced by the 62-b.h.p. Porsche GP-702/1, developed in Germany especially for this aircraft. One airframe is flying with an experimental installation of the new 55-s.h.p. Solar YT62 Titan shaft-turbine. It is due to be delivered to the Marine Corps at Quantico, Virginia, for evaluation as an aircraft suitable for observation, liaison and small unit tactical manœuvres, together with two of the standard Porsche-engined machines. A later variant is the YRON-1 with a 20-ft. rotor and overload weight of 1,043 lb. Data apply to the Porsche version.

Dimensions.—Rotor dia., 17 ft.; length, 11 ft. 5 in.; height, 8 ft.; disc area, 227 sq. ft.

Weights.—Normal take-off, 700 lb.; empty, 430 lb.; disc loading, 3.09 lb./sq. ft.

Performance.—Max. speed, 68 m.p.h.; inclined climb, 570 ft./min.; service ceiling, 6,500 ft.; range, 60 miles.



HAIG HK-1 U.S.A.

THIS two-seat light helicopter has been built to flight test a new type of rotor and control system designed by the newly formed Haig-K Aircraft Corpn. It is a simple "test-bed" prototype for the HK-2 production model which is now under construction. The HK-1 is powered by an 85-b.h.p. Continental C85 flat-four piston-engine mounted in front of the pilot and driving a three-blade main rotor and two-blade tail rotor. No other details are available.

Dimensions.—Rotor dia., 26 ft. 4 in.; disc area, 545 sq. ft.

Weights.—Normal take-off, 1,020 lb.; empty, 610 lb.; disc loading, 1.88 lb./sq. ft.

Performance.—Not available.

HILLER H-23D RAVEN AND UH-12E U.S.A.

A FEATURE of all Hiller helicopters has been the Rotor-Matic control system in which the pilot "flies" a twin-paddle servo-rotor, which in turn tilts the rotor head to produce the effect of cyclic pitch changes. The best tribute that can be paid to the resulting ease of control and stability is that the company had to more than double production of the three-seat H-23 in 1959, 10 years after the basic type entered service. Current military version is the H-23D observation/liaison/casualty-evacuation/utility/trainer for the U.S. Army, with a 250-b.h.p. Lycoming VO-435-23B engine and a transmission system designed for 1,000 hr. between overhauls. Its commercial counterpart is the UH-12E, with a 305-b.h.p. Lycoming VO-540 to which the following data apply.

Dimensions.—Rotor dia., 35 ft.; fuselage length, 28 ft.; height, 10 ft. 1½ in.; disc area, 985 sq. ft.

Weights.—Normal take-off, 2,700 lb.; empty, 1,700 lb.; disc loading, 2.74 lb./sq. ft.

Performance:—Cruising speed, 95 m.p.h.; inclined climb, 1,500 ft./min.; service ceiling, 15,000 ft.; range, 185 miles.

HILLER XROE-1 ROTORCYCLE U.S.A.

THIS one-man portable helicopter is Hiller's counterpart to the Gyrodyne XRON-1, with a 43-b.h.p. Nelson H-63B two-stroke engine and Rotor-Matic control system. The prototype flew for the first time on January 10, 1957, and in September of the following year the company was awarded a contract for five more, for evaluation by the U.S. Marine Corps. These are being built in the U.K. by Saunders-Roe, together with five commercial demonstration XROE-1s, and the first flew on October 19 this year. By removing 13 quick-release pins, one man can fold the XROE-1 into a small package for transport and air-dropping. Reassembly takes only a few minutes.

Dimensions.—Rotor dia., 18 ft. 6 in.; height, 6 ft. 11 in.; disc area, 268 sq. ft.

Weights.—Normal take-off, 496 lb.; empty, 300 lb.; disc loading, 1.85 lb./sq. ft.

Performance.—Cruising speed, 52 m.p.h.; inclined climb, 1,160 ft./min.; service ceiling, 13,200 ft.; range, 166 miles.

International VTOL Survey . . . .

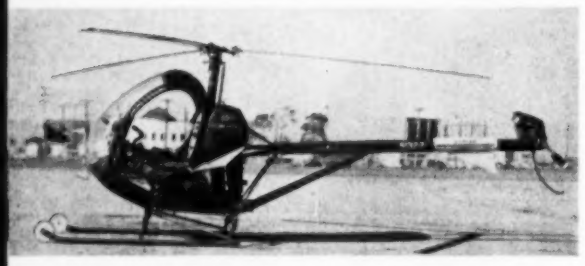
HILLER X-18 U.S.A.

ORDERED by the U.S.A.F. in February 1957, this large tilt-wing research aircraft was produced comparatively quickly by utilizing the tail surfaces and fuselage nose section of a Chase YC-122 transport and two of the 5,850-e.h.p. Allison T40-A-14 turboprops from the now-abandoned U.S. Navy VTOL "tail-sitting" aircraft programme. These engines drive six-blade contra-props, which work as rotors to lift the aircraft vertically when the wing is tilted at 87° to the horizontal, and as ordinary propellers in cruising flight with the wing at an incidence of 4°. Pitch control during vertical flight and conversion is provided by diverting the efflux from a Westinghouse J34 turbojet mounted in the rear fuselage. The X-18 flew for the first time from Edwards AFB on November 24 this year as a conventional aeroplane with the wing fixed at 10° to shorten the take-off run.

Dimensions.—Span, 48 ft.; length, 63 ft.; height, 24 ft. 7 in.

Weight.—Normal take-off, 33,000 lb.

Performance (estimated).—Max. speed, 250 m.p.h.; max. speed at which wing may be tilted, 178 m.p.h.



HUGHES MODEL 269A U.S.A.

THIS two-seat ultra-light helicopter has undergone considerable development since the original Model 269 was built in 1955-56 as a private venture. In particular, the five Model 269As being built for evaluation by the U.S. Army, under the designation YHO-2HU, have a braced tubular tail-rotor boom in place of the girder-boom fitted to the prototype. Powerplant of the 269A is a 180-b.h.p. O-360-C2B piston-engine, driving a three-blade main rotor and two-blade tail rotor. The design emphasis is on simplicity and flight trials have shown the aircraft to be stable and easy to fly. It is hoped to market a commercial model.

Dimensions.—Rotor dia., 25 ft.; length, 22 ft. 3 in.; height, 7 ft. 11 in.; disc area, 491 sq. ft.

Weights.—Normal take-off, 1,550 lb.; empty, 915 lb.; disc loading, 3.16 lb./sq. ft.

Performance.—Max. cruising speed, 85 m.p.h.; inclined climb, 1,100 ft./min.; service ceiling, 11,000 ft.; endurance, 2.6 hr.

KAMAN H-43B HUSKIE U.S.A.

DEVELOPMENT of this basic type began with the HOK-1 general utility helicopter for the U.S. Navy and Marine Corps, in 1950. The HOK-1 and the similar HUK-1, which remained in production until this year, are powered by a 600-h.p. Pratt & Whitney R-1340-48 piston-engine, driving two-blade intermeshing rotors, and accommodate up to four passengers or two stretchers and attendant, as well as the pilot. Eighteen H-43As for the U.S.A.F. are similar, for local crash rescue duties, carrying pilot, rescue crew of three and fire-fighting equipment. Still in production (111 ordered) is the H-43B Huskie rescue helicopter, in which a smaller and lighter 825-s.h.p. Lycoming T53 shaft-turbine enables up to 10 persons to be carried. Other features include clamshell rear loading doors and "bear-paws" for landing on all surfaces. Data apply to H-43B.

Dimensions.—Rotor dia. (each), 47 ft.; fuselage length, 25 ft.; height, 15 ft. 6½ in.; disc area, 3,470 sq. ft.

Weights.—Normal loaded, 5,870 lb.; empty, 4,278 lb.; disc loading, 1.69 lb./sq. ft.

Performance:—Cruising speed, 113 m.p.h.; inclined climb, 2,000 ft./min.; service ceiling, 25,700 ft.; range, 210 miles.

KAMAN HU2K-1 U.S.A.

ALTHOUGH this neat 11-seat all-weather utility helicopter breaks away from Kaman's traditional intermeshing-rotor configuration, it retains the familiar servo-flaps on its four metal rotor blades to eliminate the need for blade pitch-change and the associated bearings. The engine is a 1,025-s.h.p. General Electric T58 shaft-turbine and the main undercarriage units are retractable. Present orders from the U.S. Navy are for four HU2K-1s in 1959 and 12 in 1960, with plans for 24 in 1961. The type may eventually be used also for 'plane guard duties at sea, and is capable of carrying anti-submarine search and strike equipment. The prototype flew early last summer.

Dimensions.—Rotor dia., 44 ft.; overall length, 52 ft. 2 in.; height, 14 ft. 8 in.; disc area, 1,520 sq. ft.

Weights.—Max. loaded, 9,152 lb.; empty, 5,052 lb.; disc loading, 6.02 lb./sq. ft.

Performance.—Not available.

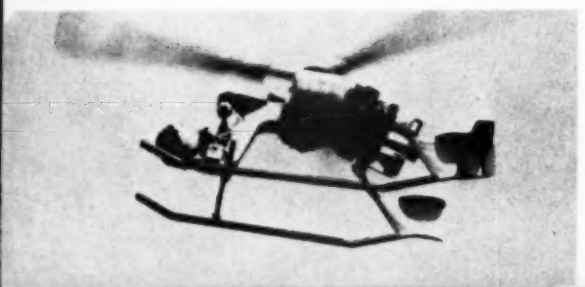
KELLETT KD-1A U.S.A.

PRODUCED orginally before the War, this two-seat autogyro is now back in production with so few changes that the original Type Certificate is valid. The fuselage is a conventional fabric-covered steel-tube structure and the engine a 225-b.h.p. Jacobs R-755-9, driving a two-blade fixed-pitch propeller. A clutch and drive-shaft enable the three-blade rotor to be set in motion by the engine on the ground, for jump-starts. Normal seating is for two in open cockpits, but the KD-1A is expected to be used mainly for agricultural duties, with a 17 cu. ft. chemical hopper in the forward cockpit. Kellett are also developing a side-by-side two-seat cabin autogyro, designated the KD-10, for military observation-liaison duties.

Dimensions.—Rotor dia., 40 ft.; length (blades folded), 25 ft. 11 in.; height, 10 ft. 10 in.; disc area, 1,260 sq. ft.

Weights.—Normal take-off, 2,200 lb.; empty, 1,500 lb.; disc loading, 1.75 lb./sq. ft.

Performance.—Cruising speed, 110 m.p.h.; inclined climb, 1,060 ft./min.; service ceiling, 14,000 ft.; range, 190 miles.



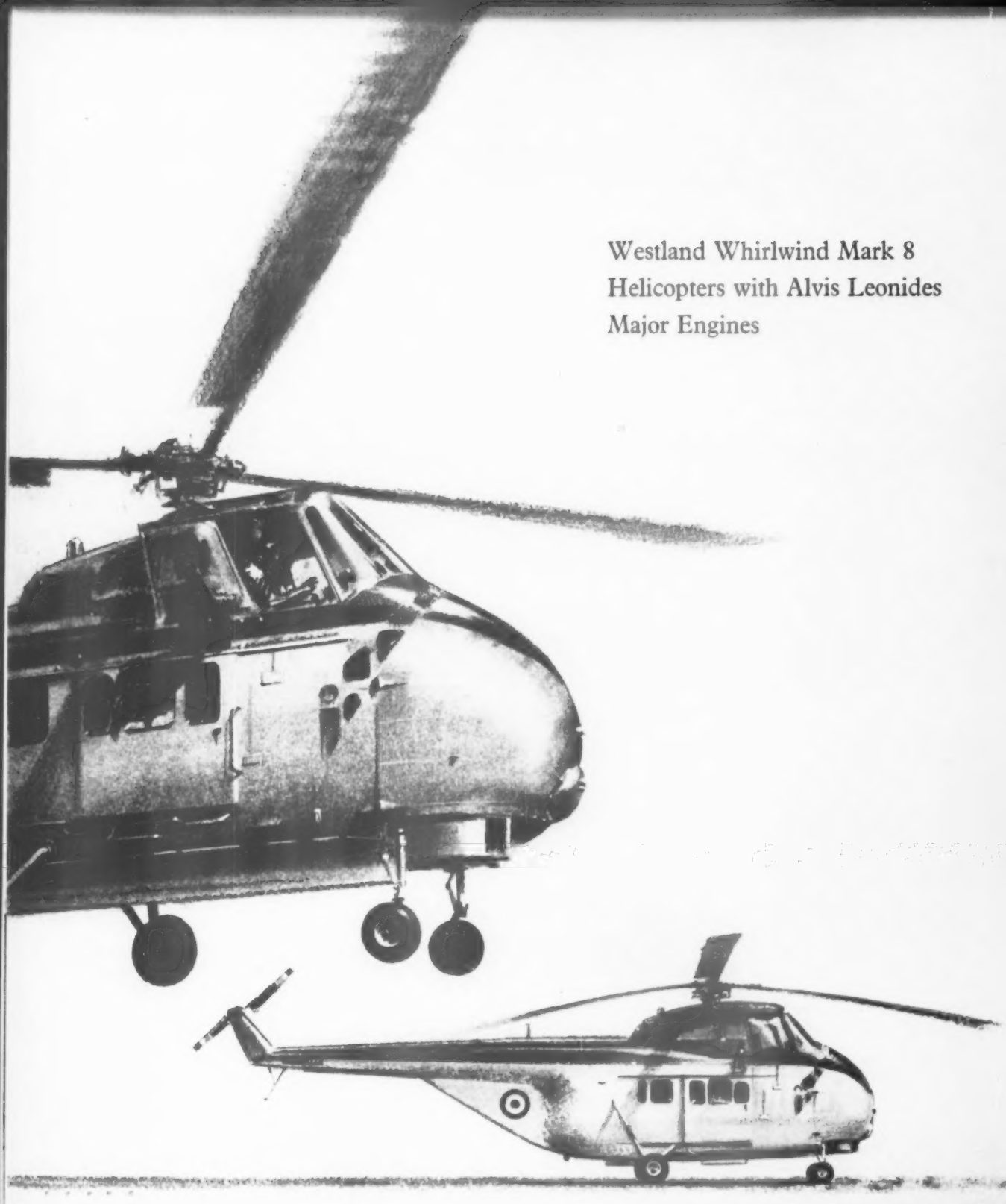
McDONNELL MODEL 120 U.S.A.

AN extremely simple helicopter, the McDonnell 120 has demonstrated the possibilities of a turbine-powered light-weight flying crane by lifting more than 1½ times its own empty weight. Compressed air for the pressure-jets built on to the ends of its three-blade rotor is supplied by three 85-h.p. AiResearch GTC-85-35 turbo-compressors. The aircraft will maintain height on any two of these, and a complete engine change can be made in five minutes without tools. For flying crane duties a pilot-controlled cargo-hook is fitted immediately under the C.G. A platform can be mounted across the undercarriage skids to carry up to 12 people, freight, or fire-fighters with fire and rescue equipment.

Dimensions.—Not available.

Weights.—Max. take-off, 6,300 lb.; empty, 2,400 lb.

Performance.—Range with max. load, 80 miles.



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Major Engines

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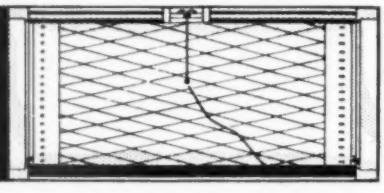
The IFALPA delegate speaking to the ICAO Special Meeting, Montreal, February 1959

I should like to describe what we have been able to do using Radar for departures. Four aircraft taxi out at the same time. They are fully loaded, it is a hot night so they have an immediate problem. After take-off Departure Control wants immediate contact so we give them a call. Number 2 aircraft takes off two minutes later, and receives the same clearance until he picks up Radar Departure, who say " Turn left heading 050° "—now this is into inbound traffic, which means he will require continuous attention from Control to make sure he picks his way safely through the incoming traffic. Aircraft number 3, two minutes later, same as before, except when he picks up Radar Control, The Controller says " hold 4,000 ft. heading 130°," (he has vectored him off so as to clear the way for aircraft number 4). Aircraft number 4 receives the same departure, but he is told to hold 3,000 ft., and the Radar Controller's attention will also be especially directed towards him because he is bucking the flow of traffic in a place where he does not properly belong.

With regard to the overall achievement, we have now vectored four aircraft into a single airway. Only one of them has achieved the altitude he wanted, and unfortunately he will have to come down through the altitude of the others. Radar is a marvellous device, and it has solved many of our problems, but it is *not* a navigational aid. An area coverage system would not solve every problem, but it would provide the capability of outbound tracks that would take us immediately out of the area from whence discrete tracks could be drawn giving lateral separation of a safe order. This is a problem which is incidental to the use of single track airways, and we feel **it can be solved by lateral separation which should be made available through pictorial presentation coupled with area coverage.**

THE DECCA NAVIGATOR



THE NAVIGATION SYSTEM FOR THE JET AGE

THE DECCA NAVIGATOR COMPANY LIMITED LONDON

International VTOL Survey . . . .

OMEGA BS-12-SC TWIN U.S.A.

DURING the past year the cabin of this very successful twin-engined general-purpose helicopter has been redesigned to give greater comfort for the pilot and four passengers, and is now 5 ft. wide at the rear. The original twin forward-undercarriage units have been replaced by a single castoring leg, with twin wheels, to improve ground handling. The BS-12-SC has two 260-b.h.p. Lycoming 0-540 piston-engines, connected by multiple rubber-belt drives to a single gearbox, from which the four-blade wooden rotor is shaft-driven. It can carry four stretchers, crop-spraying gear or 1,000 lb. of freight between the cabin and rear wheels, under the C.G. Delivery of the initial production series of 10 is under way.

Dimensions.—Rotor dia., 39 ft.; fuselage length, 36 ft.; height, 13 ft.; disc area, 1,194.6 sq. ft.

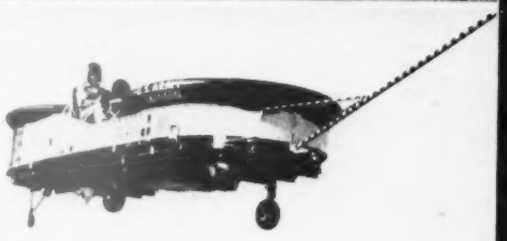
Weights.—Normal take-off, 4,750 lb.; empty, 3,350 lb.; disc loading, 3.98 lb./sq. ft.

Performance.—Cruising speed, 80 m.p.h.; inclined climb, 1,200 ft./min.; service ceiling, 10,000 ft.

PIASECKI VZ-8P U.S.A.

FIRST of the experimental VTOL "flying jeeps" ordered by the U.S. Army to fly, the VZ-8P is designed to carry a pilot and three passengers in the centre of its body, between the ducts for its two contra-rotating rigid-blade rotor/propellers. It took off for the first time on October 12, 1958, powered by two 180-b.h.p. Lycoming 0-360-A2A piston-engines. These have since been replaced by a single 425-s.h.p. Turboméca Artouste IIB shaft-turbine, offering an all-round improvement in payload and performance. The pilot's controls of the VZ-8P are of the conventional helicopter type and provide directional control through a system of pivoting vanes under the rotor ducts. Unlike the "ground cushion" aircraft now under development, the VZ-8P is claimed to be capable of crossing most of the mountain ranges in the United States; although its main tactical duties would involve flying close to the ground to take advantage of natural cover in combat areas. Max. speed is expected eventually to be over 150 m.p.h.

Dimensions, weights and performance data are not available.



SIKORSKY S-56 U.S.A.

UNTIL beaten recently by the Mi-6, the HR2S-1 version of this aircraft held the international helicopter speed record, at 162.7 m.p.h. Comparable in size with a DC-3, it was developed as an assault transport for the U.S. Marine Corps, and the HR2S-1 normally carries a crew of two and 20 fully equipped troops, 24 stretcher patients or 1,900 cu. ft. of cargo. The fuselage nose is made up of clamshell doors for vehicle loading. Freight handling is facilitated by a 2,000-lb. hoist and monorail inside the cabin, and an under-fuselage hook is provided for flying crane duties. The H-37A is a 23-seat transport in service with the U.S. Army. The HR2S-1W for the U.S. Navy has a large nose radar for AEW duties. All versions are powered by two 2,100-b.h.p. Pratt & Whitney R-2800 engines. More than 100 have been built. Data apply to HR2S-1.

Dimensions.—Rotor dia., 72 ft.; fuselage length, 82 ft. 10 in.; height, 22 ft.; disc area, 4,070 sq. ft.

Weights.—Normal take-off, 31,000 lb.; empty, 21,096–21,240 lb.; disc loading, 7.62 lb./sq. ft.

Performance.—Cruising speed, 115 m.p.h.; inclined climb, 910 ft./min.; service ceiling, 8,000 ft.; combat radius, 104 miles.

SIKORSKY S-58 U.S.A.

NEARLY 1,200 civil and military helicopters of this type have been built by Sikorsky and a turbine-powered version has been developed and produced by Westland as the Wessex. The commercial S-58C carries 12-18 passengers or eight stretchers and is widely used by Sabena and other airlines. The U.S. Army's H-34A Choctaw is similar, with attachments for flying crane duties, and has been tested experimentally with 48 by 2.75-in. rockets and four machine-guns for close support. In large-scale production are the HUS-1 utility transport for the Marines and the U.S. Navy's HSS-1N anti-submarine version with search equipment, auto-stabiliser, all-weather instrumentation and hover coupler. All have a 1,525-b.h.p. Wright R-1820-84 piston-engine. Data apply to H-34A.

Dimensions.—Rotor dia., 56 ft.; fuselage length, 46 ft. 9 in.; height, 15 ft. 11 in.; disc area, 2,460 sq. ft.

Weights.—Max. take-off, 13,600 lb.; empty, 7,646 lb.; disc loading, 5.53 lb./sq. ft.

Performance.—Cruising speed, 101 m.p.h.; inclined climb, 1,500 ft./min.; service ceiling, 12,000 ft.; range, 190 miles.

SIKORSKY S-60 U.S.A.

LIKE the Westland Westminster, this massive flying crane utilizes the well-proven rotor system of the S-56, but in this case it also has the same 2,100-b.h.p. Pratt & Whitney R-2800 piston-engines. Pilot and co-pilot sit side by side in the small cabin, the latter with a swivelling seat so that he can face rearward to control the pick-up and setting down of cargo, which is carried on a hook under the C.G. By reducing structure weight to a minimum, it has been possible to provide a payload capacity of up to 12,000 lb. This can include detachable pods for passenger and freight-carrying, and an experimental 20-seat "people-pod" was demonstrated during a recent five-week tour of military establishments by the prototype.

Dimensions.—Rotor dia., 72 ft.; disc area 4,070 sq. ft.

Weights.—Normal take-off, 31,200 lb.; empty, 19,000 lb.; disc loading, 7.67 lb./sq. ft.

Performance (estimated).—Cruising speed, 104 m.p.h.; inclined climb, 1,100 ft./min.; service ceiling, 10,800 ft.; radius of action with max. payload, 23 miles.

SIKORSKY HSS-2 U.S.A.

FIRST of the new series of Sikorsky multi-engined amphibious helicopters to fly, the HSS-2 is in production for anti-submarine duties for the U.S. Navy. The engines are two 1,175-s.h.p. General Electric T58-GE-6 shaft-turbines, and the HSS-2 is large enough and powerful enough for operation as the first American combined anti-submarine hunter-killer helicopter. It is suitable for all-weather operation and can be fitted with a 600-lb. winch and under-fuselage fittings for 6,000 lb. of external cargo. A developed 20/25-seat transport version for the U.S. Marines, is the HR3S-1, with rear loading ramp. A substantial proportion of this version will be built by Canadian Pratt & Whitney. A commercial development is the 22/28-seat S-61, of which five have been ordered by Los Angeles Airways and three by Chicago Helicopter Airways, for delivery in 1960–61.

Dimensions.—Rotor dia., 62 ft.; fuselage length, 54 ft. 9 in.; height, 15 ft. 4 in.; disc area, 3,019 sq. ft.

Weights and performance.—Not available.

International VTOL Survey . . . .

SIKORSKY S-62 U.S.A.

THIS 8/12-passenger transport set a new standard of versatility for helicopters by combining the rotor system, transmission and parts of the flying control and hydraulic systems of the S-55 with an entirely new flying-boat hull, outrigger floats and semi-retractable undercarriage. This made possible for the first time regular operation from water as well as land. Powerplant of the S-62 is a 1,050-s.h.p. General Electric T58-GE-6 shaft-turbine, the greater power and lighter weight of which enable the S-62 to carry a 700-lb. greater payload than the S-55, with full power up to 17,000 ft. Optional extras include a 600-lb. capacity winch and attachments for carrying 3,000 lb. of cargo externally in the flying crane rôle.

Dimensions.—Rotor dia., 53 ft.; fuselage length, 44 ft. 7 in.; height, 14 ft. 2 in.; disc area, 2,206 sq. ft.

Weights.—Normal take-off, 7,500 lb.; empty, 4,550 lb.; disc loading, 3.4 lb./sq. ft.

Performance.—Cruising speed, 92 m.p.h.; vertical climb, 450 ft./min.; service ceiling, 15,700 ft.

UMBAUGH MODEL 18 U.S.A.

THIS neat tandem two-seat autogyro is being produced by Fairchild, initially as a runabout, but with agricultural and utility versions projected. It is powered by a 180-b.h.p. Lycoming engine, driving a two-blade pusher propeller. Controls follow helicopter practice, but a take-off lever replaces the usual collective-pitch stick and is used only to clutch and de-clutch the engine drive to the rotor for jump-starts. It carries the usual twist-grip throttle. The rudder is operated by conventional pedals, but the tailplane functions only as a trim-tab. It is claimed that operating costs, including maintenance, would be six cents per mile at an annual utilization of 300 hr.

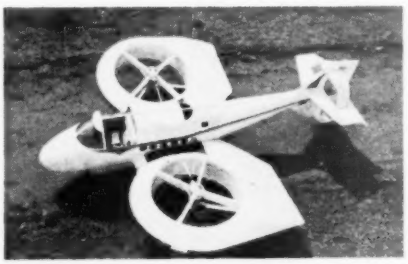
Dimensions.—Rotor dia., 34 ft. 6 in.; length, 20 ft.; height, 10 ft. 6 in.

Weights.—Empty, 1,015 lb.; max. take-off, 1,600 lb.

Performance.—Cruising speed, 100 m.p.h.; service ceiling, 15,000 ft.; max. endurance, 4.5 hr.

VANGUARD 2C OMNIPLANE U.S.A.

A detailed description of this interesting convertiplane was given in the October 2, 1959, issue of THE AEROPLANE AND ASTRONAUTICS. It utilizes the rotors, transmission and clutch of the defunct Jacobs 104 and airframe components from an Ercoupe light aircraft. Its 265-b.h.p. Lycoming O-540 piston-engine, mounted aft of the cockpit, drives both the three-blade shrouded rotors in the wings and the three-blade ducted propeller at the tail. In brief, the Omniplane takes off vertically, with the rotors absorbing the bulk of the engine power and the propeller in low pitch. At a safe height the pitch of the propeller is increased and the aircraft begins to move forward. When transitional speed is reached, the pitch of the rotors is decreased and they are covered by plate-type "lids" which, until then, have been raised clear of the ducts. The wing undersurfaces are sealed by venetian-blind covers, the rotors are de-clutched, and the aircraft cruises as a conventional aeroplane. The prototype began its ground runs on August 21 this year and is to be given 2-4 months of full-scale wind-tunnel testing, with NASA/U.S.A.F. support.



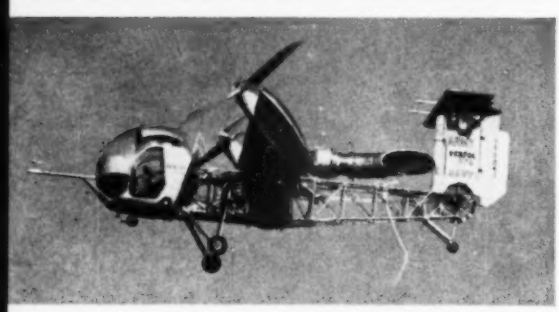
VERTOL MODEL 44 U.S.A.

THE evolution of this tandem-rotor general utility helicopter can be traced back to the original Piasecki HRP-1 of 1945. Still widely used by the U.S.A.F. and U.S. Army for transport and rescue duties is the H-21, and the current Model 44 is an improved version of this for civil and military duties. The Model 44A is a utility transport with fabric seats for up to 20 passengers, fittings for 12 stretchers and two attendants, or external attachment for 2½ tons of freight. The 44B seats 15 in an airliner-type cabin with ample baggage space, and is also used by several air forces for transport and anti-submarine duties. The 44C is an executive version. All are powered by a 1,425-b.h.p. Wright Cyclone, and can have rubberized-fabric floats and a sealed fuselage for emergency operation from water.

Dimensions.—Rotor dia. (each), 44 ft.; fuselage length, 52 ft. 6 in.; height, 15 ft. 5 in.; disc area (total), 3,040 sq. ft.

Weights.—Normal take-off, 14,350 lb.; empty, 8,990 lb.; disc loading, 4.72 lb./sq. ft.

Performance.—Cruising speed, 101 m.p.h.; inclined climb, 1,050 ft./min.; hovering ceiling with ground effect, 5,400 ft.; range, 280 miles.



VERTOL VZ-2 U.S.A.

BUILT as simply and inexpensively as possible, to prove the practicability of the tilt-wing concept, the VZ-2 (Model 76) was the first aircraft of this type to fly, in 1957. On July 23 of the following year it made its first successful transition from vertical to horizontal flight and *vice versa*. The VZ-2 was developed under joint U.S. Army/Office of Naval Research contracts, awarded in the spring of 1956. It is powered by a Lycoming T53-L-1 shaft-turbine, which drives two 9-ft. 6-in. diameter rotor-propellers mounted on the leading-edge of the tilting wing. Control during vertical flight and transition is provided by vertical and horizontal ducted fans at the tail.

Dimensions.—Span, 24 ft. 11 in.; fuselage length, 26 ft. 5 in.

Weights and performance.—Not available.

VERTOL YHC-1A AND MODEL 107 U.S.A.

FIRST version of this helicopter to fly, on April 22, 1958, was the commercial Model 107, powered by two 850-s.h.p. Lycoming T53 shaft-turbines and with accommodation for 23-30 passengers. A feature of this type is that it has a sealed fuselage to permit emergency landings and take-offs from water. The 107 has now been followed by the first of an evaluation quantity of military YHC-1As for the U.S. Army, with two 1,025-s.h.p. General Electric T58-GE-6 shaft-turbines. This is being developed into the larger YHC-1B Chinook, with seats for 40 troops, and this version is expected to go into large-scale service in due course, probably with 1,850-s.h.p. Lycoming T55 shaft-turbines. Data apply to the projected production Model 107, with 1,450-s.h.p. T58-GE-8 engines.

Dimensions.—Rotor dia. (each), 50 ft.; fuselage length, 44 ft. 7 in.; height, 18 ft.; disc area (total), 3,990 sq. ft.

Weights.—Normal take-off, 18,400 lb.; empty, 11,246 lb.; disc loading, 4.61 lb./sq. ft.

Performance.—Cruising speed, 155 m.p.h.; max. range, 390 miles.

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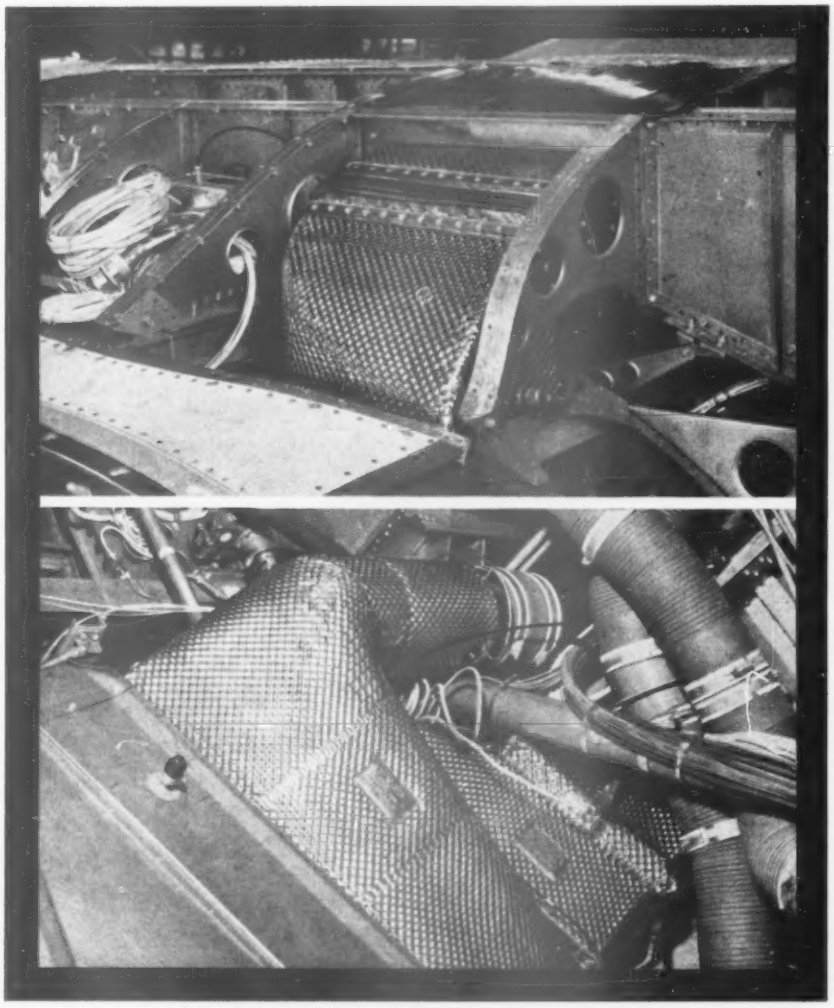

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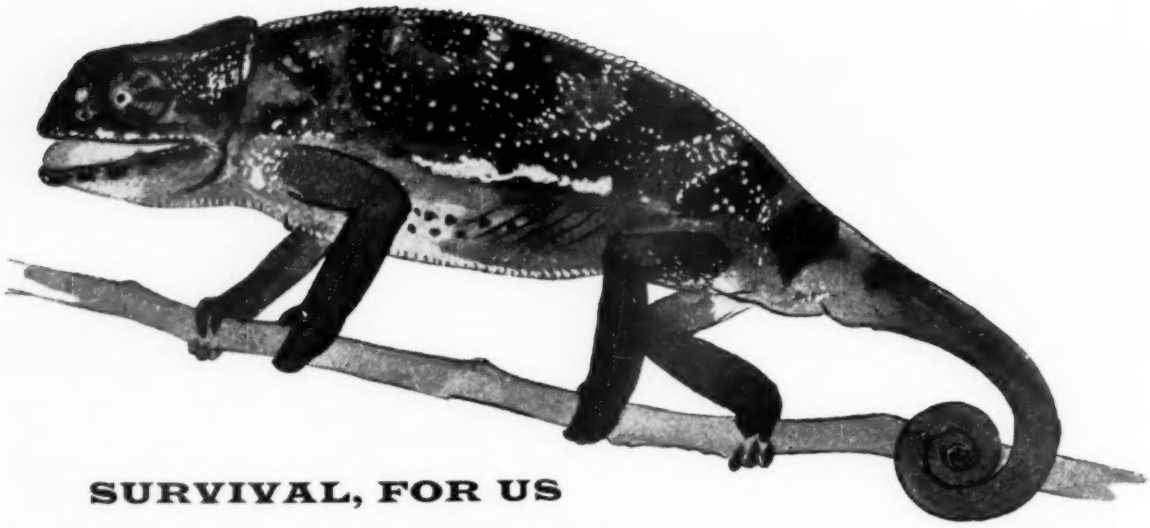

SURVIVAL, FOR US AS FOR THE CHAMELEON, DEMANDS VERSATILITY

You cannot take a chameleon by surprise. It can always adapt itself to the prevailing conditions. It owes its survival to this adaptability. The same principle applies in modern warfare. A defence system which is flexible in application is less likely to be defeated than one which is not.

A MISSILE THAT DOES TWO JOBS

Thunderbird can be used in two ways. It can be used efficiently in a static role operating from a preselected site for as long as it is tactically required there, and it needs no concreting-in. It can also be rapidly redeployed to meet some new threat should the need arise – and attack seldom hits us where we are expecting it.

Thunderbird can be moved easily and quickly – on wheels or by air. Now in service with the Army and designed round standard service vehicles it can be redeployed and in action where most needed within hours. Its inherent mobility and air transportability provides that flexibility which is of ever increasing importance in present and future air defence.

NEW DEVELOPMENTS

And evolution still goes on. Already the successor to Thunderbird has been under development for some considerable time. Using the latest techniques and retaining its full mobility, the new version will provide, among other things, increased low-level capability and longer range.

The Chameleon has survived because its versatile defence gives protection anywhere. Our own survival may equally depend on similar versatility.

'ENGLISH ELECTRIC' THUNDERBIRD

ENGLISH ELECTRIC AVIATION LIMITED · *GUIDED WEAPONS DIVISION* · LUTON · STEVENAGE · WOOMERA

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GW26

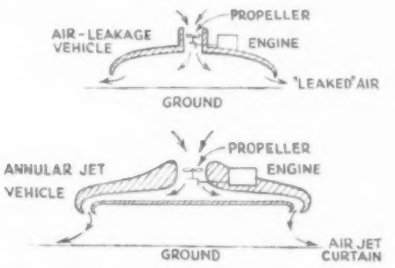
International VTOL Survey

America's "Gems"

In the United States there is a considerable amount of research and development in progress on various forms of cushion-lift craft—or, as they are known in America, ground effect machines. In this article specially written for us by HOWARD LEVY *and* MOLLY NEAL, B.Sc., D.I.C., A.F.R.Ae.S., *this work is reviewed.*

A GROUND-EFFECT or ground-cushion machine is a craft that flies a short distance above the ground by maintaining an elevated air pressure in the airspace underneath itself. Lift on the craft can be generated with only a fraction of the power used by other vertical-rising aircraft provided that the craft stays near the ground. The ground-cushion craft loses its advantage if designed to fly at heights greater than a fraction of its average size.

Utilization of the ground-cushion principle is therefore limited to three categories: (1) Very large craft, upwards of 100 ft., flying 10-20 ft. above the surface, high enough to fly over the ocean or moderately rough terrain. (2) Moderate-size craft, flying very close to the surface, limited to relatively quiet water or smooth terrain. (3) Craft which use the ground-cushion principle for a landing gear and operate like conventional aircraft when in flight. Vertol are working on a project of this type.



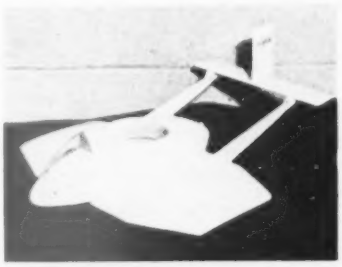
The two basic types of ground effect machine: the air leakage or plenum-chamber vehicle, and the annular or peripheral jet vehicle.

Utilization of the "plenum chamber" or "air leakage" principle is the simplest method in which pressure can be maintained in the airspace under the craft. This is graphically, if not wholly accurately, described by saying: "you simply pump air under the craft faster than it can run out." In the air-leakage craft, the "leak" is the space between the outer edge of the craft and the ground. The higher the vehicle flies, the bigger the leak and the more power it takes to pump the necessary air.

The "annular" or "peripheral" jet is a more sophisticated means of maintaining the ground cushion, a curtain of air being exhausted towards the ground from the periphery of the craft. Rather than replenish the ground-cushion air from within, the annular jet contains it from without, preventing it from leaking away. Power, of course, is still required to generate the jet.

However, for a given altitude, size and weight of craft, the power requirement promises to be significantly less than for the simpler air-leakage machine. With proper orientation of the jet, lift and propulsion will be provided efficiently by the same system.

Forward flight of ground-cushion craft may be achieved in one of three ways—tilting of the entire vehicle or use of vanes in the jet exits; separate forward-thrust engines mounted atop the craft or discharging horizontally to the rear; or convertible engines that may be used for primary lift with part of the thrust available for forward speed. Thrust for very low forward speeds may be achieved by merely tilting the craft or changing the angle of discharge to produce a component of jet momentum in the flight direction. Tilting can be accomplished by means of reaction jets, turning vanes, re-ducting or differential thrust in a multi-engine configuration.



20-in.-span wind tunnel model of a Vertol project. Air supplied by a ducted fan is ejected from a peripheral slot below the wing to provide ground cushion, and from the trailing edge of the wing for forward thrust in flight.

Small separate thrust engines for speeds in the medium range will probably be in the form of simple propellers or ducted fans. Convertible engines of the gas-turbine type will be most adaptable to higher speeds. Such installations will require special valving and ducting for transfer of the available flows from primary lifting to horizontal thrust.

In the United States the present widespread interest in ground-cushion craft seems to have begun officially in April, 1957, with publication by the Lewis Laboratory of the then NACA of a report describing some simple annular jet experiments. The stimulation provided by this report had the immediate effect of causing the Navy to establish a research programme at the David Taylor Model Basin.

Just three months later, in July, 1957, this programme produced a comprehensive understanding of the fundamental annular-jet ground-cushion phenomena, complete with working formulæ. It has emerged that an amazing number of people—companies, large and small; scientists; inventors; hobbyists; and back-yard mechanics—were already working with ground-cushion devices of one sort or another, even before the publication of the April, 1957, NACA report.

One of the earliest experimenters in ground-cushion effects

Four American "Gems" on view at the James Forrestal Research Centre, Princeton University: in the foreground, National Research Associates' FASS (Free Air Suspension System) vehicle for the U.S. Army; in the left background, the Princeton X-3; centre back, the Princeton X-2; and on the right—set up on its side—Dr. Bertelson's home-built Aeromobile.

International VTOL Survey . . . .

was Dr. Andrew A. Kucher, now vice-president, engineering and research, of the Ford Motor Co. He was thinking in terms of "sliding on air" as long ago as 1928.

Another pioneer is Mr. Toivo J. Kaario, of Finland, who tested a craft in 1935, first as a glider and later with a 16 h.p. Davidson motorcycle engine. It measured 6 ft. by 8 ft., and attained a speed of 12 knots over ice on its first "flight." His next attempt, a craft 8 ft. by 10 ft., took off from water and was capable of lifting four men. World War II interrupted this development, but the programme culminated in test flights during 1949 and 1950.

In America, known projects include: Spacetronics' "air-leakage" craft, to carry eight men, on order for the Marine Corps; National Research Associates' Pegasus I; Bertelsen Aeromobile; Ford Levacar; Curtiss-Wright Air-Car; Gyrodyne Corporation of America's research craft (BuAer contract); and model work being carried out by the Navy's David Taylor Model Basin, NASA's Langley and Ames Research Centers, and Princeton University. Aircraft concerns such as Convair, Grumman, Hiller, Lockheed, North American, Sikorsky and Boeing are also said to be actively interested in ground-cushion craft.

Navy Research Projects

The studies sponsored by the U.S. Office of Naval Research have shown that stability and control of ground-cushion craft in the hovering case do not appear to present difficulties. In fact, models and research craft now flying exhibit quite stable behaviour in hover at low height ratios. However, transition and forward flight of these craft may present more serious problems.

Special problems also arise over water because of the nature of the free surface on which the jets impinge. Numerous investigators are at work examining the surface phenomena and outlining the problems remaining to be solved. Initial tests indicate that vertical jet discharge into the water is undesirable because of the large cavity produced. The absorption of the jet momentum in creating the cavity precludes the jet spreading over the surface and hence produces little lift. Either a positive or negative angle of discharge reduces the depth of the cavity, and thus restores a large fraction of the solid surface augmentation.

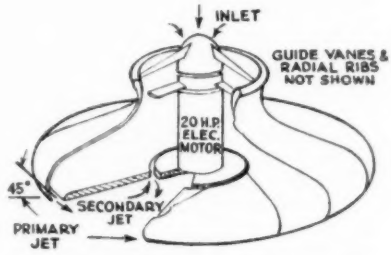
Experimental work is being carried out at the David Taylor Model Basin with models over water with varying discharge angles of peripheral sheets. Several man-carrying craft have been successfully demonstrated over both land and water—that is, successful in that they are able to hover and accomplish forward flight. Future transport needs, both commercial and military, will demand increased speed and mobility over a variety of surfaces. There are many problems still to be solved which can only be accomplished through continuing careful research.

Two important research models have been developed at the David Taylor Model Basin, a 3-ft. powered model and a 7-ft. captive dynamic model operating over a circular test track. The 3-ft. model, which they call the Skimmer, is an annular jet vehicle and has been the work-horse of the research programme. Nearly 100 hours of testing have provided confirmation of the basic theories, guidance for refinement of the theories, comparisons between performance over hard surface and water surface, effects of dozens of changes in vehicle geometry, etc.

The model is now being tested in a wind-tunnel, providing additional answers as to how the ground cushion is affected by forward speed. The 3-ft. model is powered by a self-contained 20-h.p. water-cooled electric motor. In its basic configuration, the main nozzle is 0.9 in. wide, angled inward 45°. This model will be supplanted by a more advanced powered model, an oval-shaped four-motored design with improved speed characteristics.

The 7-ft. dynamic model is being used to make carefully scaled flights over systematically varied surface shapes to determine what combinations of vehicle characteristics and flight conditions are acceptable for safe flight. This 300-lb. model gets 50 lb. of lift from its compressed-air power units and 250 lb. from the ground cushion—a "lift augmentation factor" of 6.

Power for this model comes from 2 lb./sec. of compressed air, delivered through flexible hose and exhausted through eight nozzles into the top of the fin-like structures at the sides. Here the compressed air is mixed with an additional 18 lb./sec. of air drawn from the atmosphere by aerodynamic induction. This air mixture is distributed to the nozzles in the base, where it forms a jet exhaust comparable to that which should be generated by the engine-driven shrouded propellers of an actual vehicle.



David Taylor Model Basin's 3 ft. dia. Skimmer.

Movable vanes in the peripheral jet exhaust control the flight direction and speed. Forward speed over the 45-ft.-diameter test track is limited, by centrifugal loads, to about 20 m.p.h., which is adequate for scaled simulation of much higher speeds.

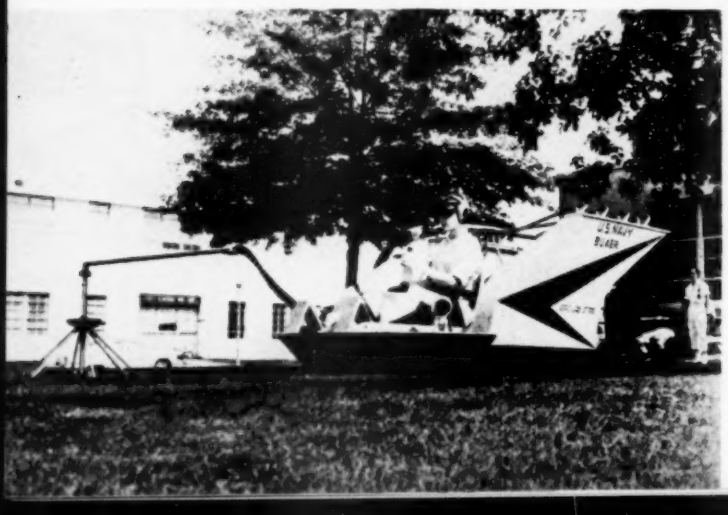
Princeton's Scooter and Saucer

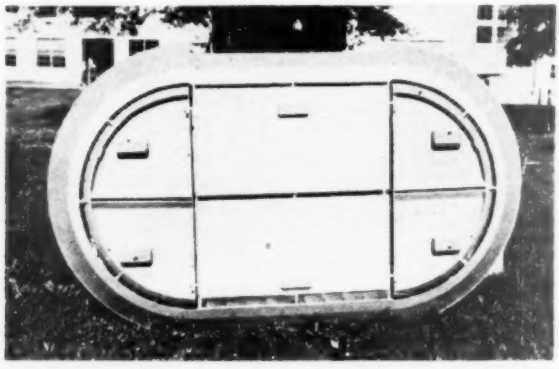
Princeton University's James Forrestal Research Center is carrying out a number of studies on ground-effect phenomena under a $100,000 grant from the Army's TRECOM (Transportation Research and Engineering Command). Their first man-carrying vehicle is the X-2 Air Scooter and was designed primarily to investigate the feasibility of kinesthetic control—that is, control by movement of the pilot's body.

The Air Scooter has a circular base with a bicycle seat and handlebars, the latter modified with a twist-grip throttle. Power is supplied by a 5-h.p. Tecumseh Power Products Model H-81 engine, driving a 26-in.-diameter specially designed Sensenich ducted propeller mounted perpendicular to the base of the scooter.

Air is ducted down to the saucer-shaped base and emitted through a 1½-in. slot around its outside under-surface. This slot is angled inward, and this, together with a 4-in. hanging skirt, retains the 6 lb. per sq. ft. peripheral jet curtain under the vehicle.

The structure comprises an aluminium tube frame with aircraft fabric covering. The main forward part of the pro-





Two views of the David Taylor Model Basin's 7-ft. dynamic model. Above, the underside showing the primary peripheral nozzle, and the smaller secondary nozzles which divide the base into six segments giving additional stability. Left, the model on its circular track.

peller duct is metal and the curvature is formed by a series of fabric-covered steel rings. The fin is plywood.

The saucer diameter is 8 ft. and its overall height, 47 in. The empty weight is 120 lb. and the gross weight up to 750 lb., as the Air Scooter can carry up to three people. With one aboard, the normal operating "altitude" is 4-5 in. and the forward speed about 9 m.p.h. To date, 10-15 hours of "flight" time has been accumulated.

Princeton's X-3, which made its first flight on October 18, is as close as one can get to a flying saucer. At speeds of about 20 m.p.h., its aerofoil body develops aerodynamic lift and shallow banked turns can be made. It has a 20-ft. diameter and is only 5 ft. high at the fin. It is of aluminium tubing construction with fabric covering.

A 44-h.p. Nelson H-63B engine drives a 4-ft. propeller at 4,000 r.p.m. and both are mounted in a centrally positioned duct, the engine vertically and the propeller horizontally. Directional control is obtained by electrically actuated vanes mounted in a 6-in. slot which rings the base of the X-3. There are 32 vanes grouped in segments of eight to provide fore and aft and sideways control.

A 5-h.p. Power Products engine driving a 26-in.-diameter propeller is mounted in the fin; actuated by the pilot's foot pedals, it can swing 90° to the right and 90° to the left, to provide yaw control. In the central "pusher" position this propeller provides forward thrust.

A bubble-canopied cockpit is situated in the forward part of the "saucer," and a 5-gal. fuel tank is located forward of the tail fin, while the power packs, including battery, electronic control, inverter and radio, are placed in the "saucer" under the fin. The X-3 weighs 850 lb. empty and has a gross weight of 1,000 lb. A pressure of 3½ lb./sq. ft. is expected to give the craft an operating height of about 16 in.

N.R.A. Efforts

GEM-1 (Ground Effect Machine-1) is the name given to a vehicle under development for the U.S. Marines by National Research Associates, College Park, Maryland. This organization claims to be a pioneer and leader in the field of ground-proximity vehicles since they first started research in early 1950, pre-dating NACA studies and, in fact, stimulating the Navy's interest in such projects through their presentations.

National Research Associates began their work with a three-dimensional test stand using cardboard, and operated by a vacuum cleaner to study the principle of their Free Air Suspension System (FASS). Small balsa and paper models followed and on May 1, 1958, the Ordnance Tank Automotive Command (OTAC) of the U.S. Army let a contract to construct and test a feasibility model.

An unmanned model, 5 ft. wide by 10 ft. long, was completed in November, 1958, and successfully demonstrated to

The Princeton X-2 Air Scooter is controlled by body movements.

OTAC. In June, 1959, N.R.A. received a contract from the U.S. Marine Corps for the construction and demonstration of two two-place vehicles, the first to be constructed and tested, and then the second to be built, incorporating any necessary modifications. In the meantime, the Ordnance Corps of the U.S. Army let a contract for a test vehicle of similar design to the GEM, and OTAC an additional Research Program contract to cover optimum-lift studies.

National Research Associates' GEM/FASS (the latter the Army's name for ground proximity vehicles) uses the peripheral jet principle. The vehicles have a basic structure of aluminium alloy with the internal air ducts and body shell of glass-fibre. Fore, aft and sideways movement control is achieved by deflection of the jet sheet, this being obtained by the use of vanes situated in the 10-in. slot around the vehicle.

Power is supplied by two Triumph TR-6 piston engines of

The Princeton X-3 Saucer prior to covering with fabric. Cockpit is in the forward section, ducted powerplant and propeller in the centre, and yaw/thrust control engine and propeller are mounted in the tail fin.

40 h.p. each, with each engine driving two six-bladed 42-in.-diameter Hartzell propeller fans specially adapted for N.R.A.'s use. Connection between engine and fans is by 1½-in.-diameter U.S. Rubber timing belts.

The propeller fans are individually shrouded, two forward and two aft in 6-in. high shrouds, with the fan shaft mounted at 30° to the vertical. The front and rear slots have an inward discharge angle of 30°. Stator blades in the fore and aft ducts are used to compensate for fan torque.

Normal operating height of the GEM-1 is 9-15 in. with the vehicle maintaining 10 lb./sq. ft. pressure. At 9 in. altitude, approximately 50 h.p. of the available total of 80 h.p. is utilized. Propeller fan r.p.m. at 9 in. is 5,200 r.p.m., and 5,800 r.p.m. at 15-in. "altitude."

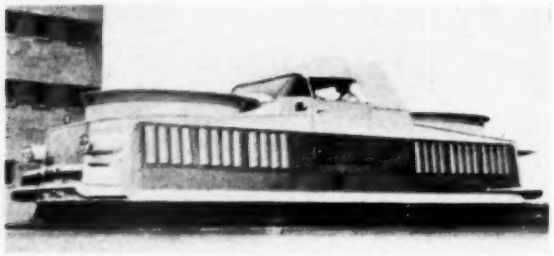
The Marines' prototype GEM-1 was completed on August 28 and has some 10 hours of engine operating time. Some 2 hours of "flight" time in all directions have been accumulated and a top speed of 15-20 m.p.h. has been realized to date. Design cruising speed of the craft is 38-58 m.p.h. The GEM-1 and its commercial counterpart, the Pegasus I, have a length of 14 ft. 7 in.; width, 8 ft.; and height, 3 ft. 5 in. Empty weight is 358 lb. and gross weight 1,000 lb. Seating arrangement is side-by-side.

National Research Associates have also been carrying out studies of more powerful versions of the GEM, the commercial Pegasus I and II, powered by two 65 h.p. and two 85 h.p. Continental engines respectively and having operating heights of 3 ft. and 4 ft. N.R.A. believe that they will be able to produce commercial vehicles at a cost equal to the better present-day American automobile if done in units of 1,000. Other military studies include a remote-controlled ASW Killer measuring 25 ft. by 50 ft.; a 1,600-lb. plenum-chamber vehicle powered by two 40-h.p. Triumphs, measuring 12 ft. by 27 ft., and capable of lifting to 20 in.; and still other projects capable of operating at 20 ft.

The Gyrodyne Company of America, Long Island, N.Y., is also engaged in the design, development and test-flight programme of a one-man ground-effect machine under a BuAer, U.S. Navy contract. The purpose is to provide a test-bed for investigating the feasibility and aerodynamic aspects of the annular air jet as a ground cushion and propulsion means for vehicles up to several hundred feet in size which could operate at speeds of 100 knots or better.

Gyrodyne's GEM is designed to carry one man whose weight

Gyrodyne's one-man GEM, powered by a 1,600 c.c. Porsche engine driving a fan compressor supplying an annular jet.



Curtiss-Wright four-passenger Model 2500 Air-Car now in production.

is diametrically offset by the powerplant—a Porsche 1,600-c.c. automotive engine similar to those used in their X/YRON-1 Rotorcycle helicopters. The annular opening through which air enters to be compressed by the Porsche-driven fan compressor is located aft of the pilot, in the centre of the duct.

This air is then ducted to an annular jet in the periphery of the base and to radial slots in the base. These slots provide stability as well as contributing to the lift provided by the annular jet sheet. Thus, the craft is supported above the ground on a cushion of air enclosed by the annular jet sheet.

Control of the vehicle is obtained by means of jet vanes located in the annular exit and the pilot operates controls which were adapted from the Rotorcycle. These consist of a throttle control for raising the machine off the ground, rudder pedals to turn left and right, and the conventional control column, which directs the airflow for horizontal movement.

The craft is designed to operate within close proximity to the ground or just high enough to clear its four landing pads. It has a 6 ft. diameter and is slightly over 4 ft. high. Fully loaded with pilot and fuel, it weighs approximately 600 lb.

Aeromobiles, Air-Cars and Levacars

Among the private ventures, William R. Bertelsen of Neponsit, Illinois, a designer-engineer, has been "flying" a ground-effect machine, the Aeromobile, for some time now, and believes that he has beaten some successful models like the

Dr. Andrew A. Kucher at the controls of the Ford Levacar Mark 1. Air is supplied to the three Levapads underneath from an external source.

Curtiss-Wright Air-Car and Saunders-Roe Hovercraft into the air. In his craft, a ducted propeller carries air down to a chamber above the metal bottom plate of the craft, where the jet air escapes through a slot running around the edge of the platform. Movable flaps control the jet flow for steering.

Jet air coming out of the slot hits the ground, part of it bending up and back under the sled, thus providing the lift. Initially, the Aeromobile was powered by a 35-h.p. Righter engine, but is now being tested with a McCulloch 72-h.p. two-cycle four-cylinder engine.

The structure consists of sheet aluminium, spruce and plywood. The 30-in.-diameter propeller, of maplewood, has eight blades with 26° pitch at 0.75 radius and 12° twist; the hub diameter is 11 in.

The Aeromobile has an empty weight of 408 lb. At the gross weight of 583 lb., the operating height is 6 in. and the maximum forward speed is 40 m.p.h. The vehicle is 32 in. high, 71 in. wide and 101 in. long, with a total base area of 6,731.7 sq. in. and a centre body area of 6,178.5 sq. in. The jet perimeter is 324.6 in. and the jet width is 2 in.; the effective jet area is 553.2 sq. in. It has cost about $1,700.

Production of the Curtiss-Wright Corporation's 300-h.p. four-passenger Model 2500 Air-Car was due to begin at the South Bend, Indiana Division, in November, 1959. The newest model of their ground-cushion vehicle is 21 ft. long, 8 ft. wide and weighs approximately 2,800 lb. with four passengers and a full petrol load. As with its original prototype design, the Model 2500 also maintains a pressure of 0.1 lb./sq. in. underneath, augmented by a deflection membrane.

The Air-Car travels at speeds up to 60 m.p.h. at a height of about 10 in. Air-Bus and Air-Truck designs have also been completed, and these are also to be produced at a later date at South Bend. In the meantime, Curtiss-Wright is setting up a new 25-mile economical-type highway in Reno, Nevada, to demonstrate the Air-Car's operation over mountainous and desert terrain at altitudes up to 7,000 ft.

The engineering and research staff of the Ford Motor Co. first demonstrated its application of "levitation" in April, 1958, with a 3-ft. model of a car and a scooter which the company calls Levacar and Levascooter respectively. Their system involves the use of a lubricating air film rather than a cushion. Development has continued and the Ford Co. is now demonstrating and testing a full-scale wheel-less air-propelled vehicle called Levacar Mark I.

The Levacar Mark I is a captive vehicle, and while it receives its air supply for the ground cushion from an outside source, it is propelled by its own motor, a blower rated at 1½ h.p. delivering 7 lb. thrust. The car is constructed of aluminium and has a large transparent canopy affording the operator maximum visibility. It weighs about 450 lb., is 94 in. long, 48 in. high and 54 in. wide.

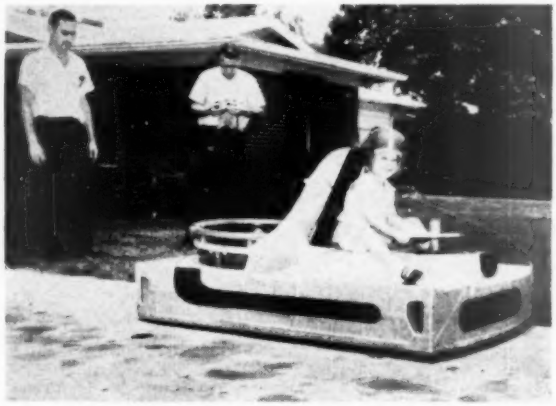
It has three Levapads 7 in. in diameter and requires a pressure of about 50 lb./sq. in. Electric controls enable the driver to levitate, start and stop the car by push-buttons. Only 15 h.p. is required to levitate and just 1½ h.p. to propel the car by means of an air jet expelled from the rear. Top speed is given as 20 m.p.h. and the vehicle travels on a film of air a fraction of an inch above a 34-in.-diameter circular track.

Actually, the Levacar is proposed as a rail vehicle for high-speed travel in the intermediate distance range of possibly 100-1,000 miles. The Ford company foresee these vehicles as single-unit cars capable of speeds of 200-500 m.p.h., operating on a city-centre to city-centre basis. They are currently constructing a four-passenger Levacar, but as yet the powerplant has not been decided. A six-eight passenger vehicle to operate at about 200 m.p.h. on rails will probably follow.

"Kiddie Kushion"

Two Bell Helicopter research engineers, Ken and Rod Wernicke, are using a home-built, child-carrying ground-cushion vehicle as the basis of a study for a man-carrying craft. Called the Kiddie Kushion, the test rig is constructed of a cardboard airframe held together by masking tape; it cost approximately $2.00. In contrast, however, the ducted fan borrowed from Bell's Research Group is completely instrumented with strain gauges and is worth several thousand dollars.

The Kiddie Kushion is a plenum-chamber type ground-cushion vehicle, 5 ft. long and 3 ft. 4 in. wide, weighing 35 lb. empty. The ducted fan is situated aft and consists of a 22-in.-diameter two-bladed propeller. Power is supplied by a 7½-in. Craftsman electric saw motor and with Ken's four-year-old daughter Fonda at the controls the Kiddie Kushion has a gross weight of about 67 lb. and the motor develops approximately 1.2 h.p. Hovering height at these conditions is 1 in. and the craft moves at walking speed.



The Kiddie Kushion, a plenum-chamber type ground cushion vehicle built privately by two Bell Helicopter engineers.

International VTOL Survey . . . .

Report on London's Heliport

Photograph copyright "The Aeroplane and Astronautics"

The traffic controller, at his desk, watches a Bristow Widgeon as it prepares to settle on the touch-down area.

ONE of the unwritten rules for eventual success in any new industry—whether for the manufacture of reliable flint arrowheads or for the operation of satisfactory inter-city helicopter services—seems to be that you cannot afford to wait until somebody else has shown you how it can be done. Some practical experience of basic problems is necessary if any useful advantage is to be obtained from the wrinkles which other pioneer flint workers (or city-centre heliport operators) can offer.

From the moment when London's South Bank heliport was closed, in 1956, until April this year there was no official helicopter port for London—and, consequently, no means of learning more about the real day-to-day problems involved in the regular, safe operation of helicopters in and out of a heavily built-up area. Army and Navy vehicles continued (and still continue) to roam in and out of sundry vacant open spaces on special missions—but these flights had not been producing anything much more useful than success figures to feed into sums dealing with the statistical probability of accidents in the present state of city-centre operations.

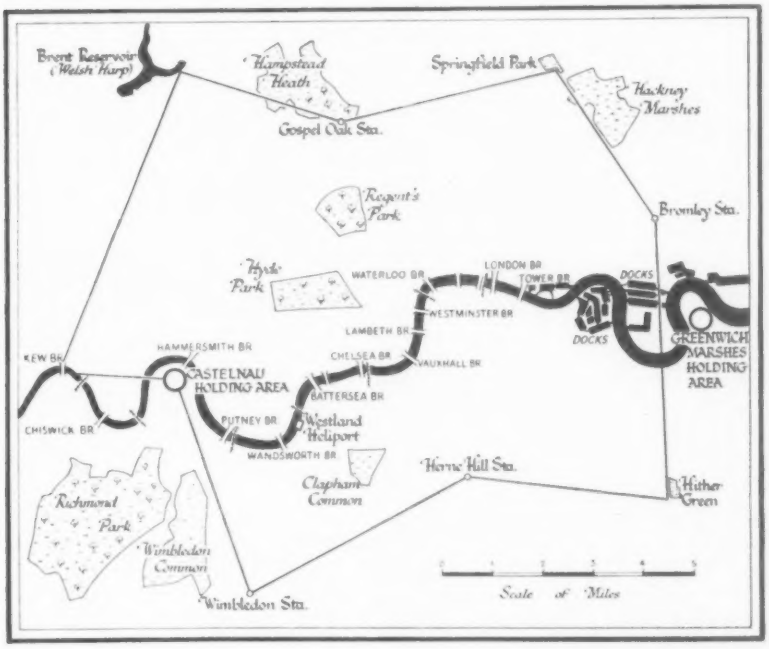
Nobody will pretend that Westland's Battersea heliport is ideally placed, or, as yet, completely and finally equipped—but it does provide a London operating base and, most important, the means of learning something more about the problems of operations to and from a city which is lucky enough to have a widish river meandering through its centre.

It has, too, shown that there is, even now, plenty of prospective traffic. The average monthly movement figures have been much higher than were expected and will probably rise to 200 or more next year. Even during the first five months they have averaged 150 or so per month outside the special circumstances of the *Daily Mail* Race and the Farnborough services which boosted the July and September figures to 387 and 306 respectively. The other movement totals were: May, 124; June, 172; and August, 143.

Since operations with single-engined helicopters are necessarily completed visually, and winter daylight hours are few, a primary development need has been that of night-flying facilities. Trials, using glim lamps, were made recently and a permanent lighting system has now been laid down and may be in operational use (with the heliport licenced for night flying) before this article appears. The system will include "texture" lighting as well as platform-boundary and river-navigation lighting. At present its primary value will be that of allowing flights to start before dawn and to finish after sundown so that maximum work can be done during the short winter days.

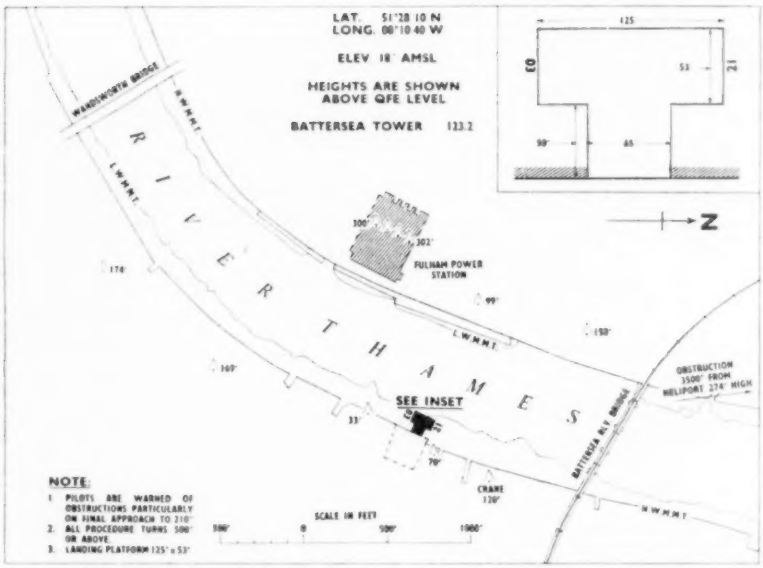
In due course, when commercial helicopters with a certificated engine-out performance are available, freedom of flight over central London will be safely practicable. At present this freedom is enjoyed only by Service crews; civil helicopters are sensibly restricted to flight along the river within the prescribed area shown in the sketch map on this page.

Helicopters leaving London from the heliport must follow the river to Castelnau or to Greenwich and must fly in from these points. There are holding areas over Castelnau reservoir and Greenwich marshes, where in case of congestion within the London area, or other circumstances, helicopters circle



Except when following the Thames civil helicopters are not permitted to fly within the marked area shown in this map of the approaches to London's heliport.

International VTOL Survey . . . .


LAT. 51°28 10 N
LONG. 00°10 40 W
ELEV 18' AMSL
HEIGHTS ARE SHOWN ABOVE QFE LEVEL
BATTERSEA TOWER 123.2
WANDSWORTH BRIDGE
R I V E R T H A M E S
FULHAM POWER STATION
SEE INSET
BATTERSEA RLY BRIDGE
OBSTRUCTION 3500' FROM HELIPORT 274' HIGH
CRANE 120'
NOTE:
1. PILOTS ARE WARNED OF OBSTRUCTIONS PARTICULARLY ON FINAL APPROACH TO 210°
2. ALL PROCEDURE TURNS 500' OR ABOVE.
3. LANDING PLATFORM 125' x 53'
SCALE IN FEET
N

International Aeradio's landing chart for the heliport showing the position and heights of the major obstructions.

until the controller at the heliport can give them clearance.

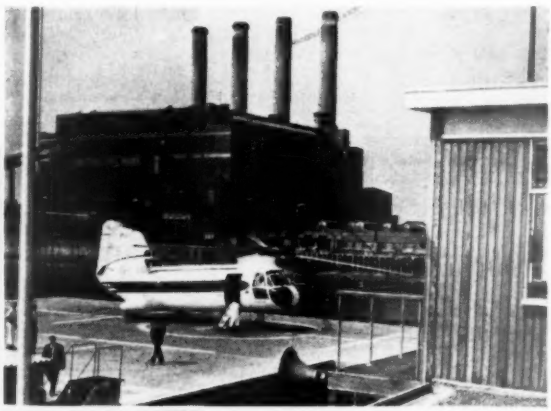
Outside the London area there are special lanes from Kew at the westerly end, where London Airport traffic is involved, but there are no particular problems at the easterly end, where north-bound helicopters may, for instance, choose to follow the Lea valley. Revised helicopter lanes are proposed and these are expected to come into use shortly.

The problem to be remembered is that L.A.P. is only 11 miles from the heliport and, at the western end of the prescribed London area, fixed-wing aircraft are flying, on approach or after take-off, at altitudes which demand detailed traffic co-ordination between the heliport controller and the controllers at London Airport. Clearance must, in fact, be obtained in the usual way for the use of the outbound and inbound lanes. At L.A.P. helicopters now use Stand 37, which is at the south-east corner of the south-west apron.

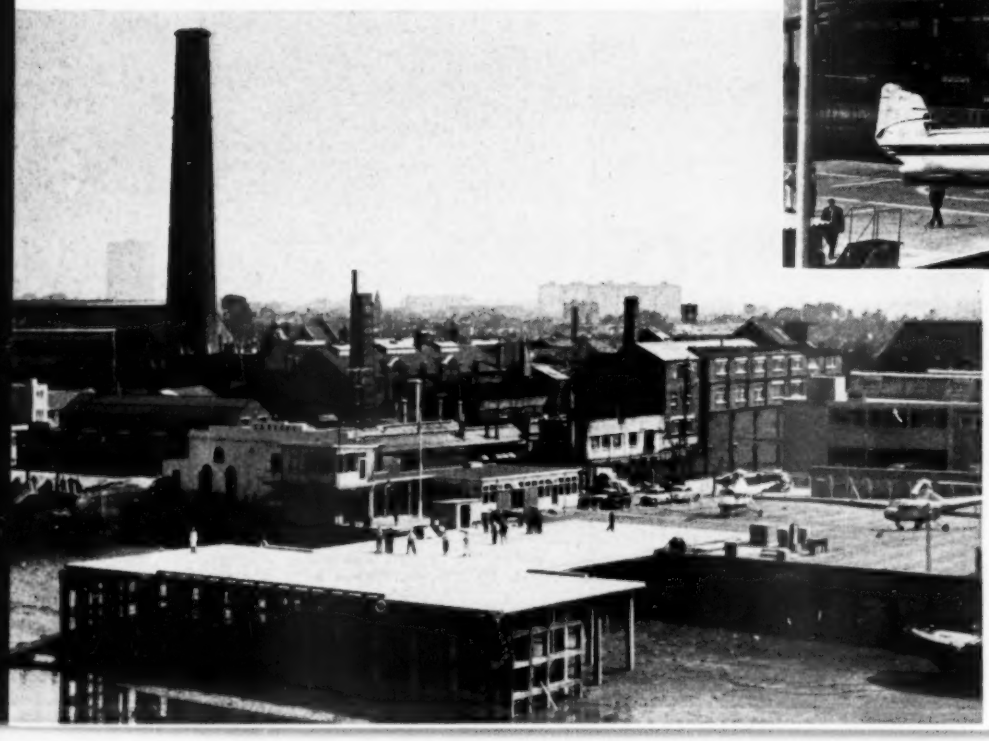
The present weather minima for the heliport are ½-mile visibility and a 500-ft. cloudbase. These minima are low enough for helicopter operations in an area which is certainly not without its obstructions and difficulties even for an aircraft which can move slowly—or "stop"—at the cost of choosing an altitude which is outside the safety envelope for hover or near-hover conditions.

The acceptably safe method of organizing a departure from the heliport is that of climbing into wind (or as nearly as is appropriate while staying over the river) to about 500 ft. before turning on course either up or down river. The really major obstruction in the area—the Fulham power station (300 ft.) on the north bank—is massive enough to be obvious even in low-visibility conditions. More troublesome are the cranes and less easily seen obstructions such as chimneys—but the latter are set fairly well back from the river and the cranes have floodlights when in action and are, when not in use, "parked" with their jibs lying more or less parallel to the river bank.

London's heliport is managed from day to day and the traffic (which must have adequate RT equipment) is controlled by International Aeradio under contract with Westland Aircraft. This arrangement has a specific advantage for I.A.L., whose staff—J. G. S. McHutchon (manager) and P. D. Bayetto—are able to obtain first-hand experience of the specialist problems involved, and to bring this experience up to date as new helicopters and new navigation and lighting aids come into use.



Above, the Vertol 107 demonstrator at the heliport, with the Fulham power station in the background.



Left, the heliport area and control tower as seen from a helicopter—actually the S-62 which was recently demonstrated at Battersea.

Photographs copyright "The Aeroplane and Astronautics"

Astronautics and Missiles

British Astronautics

This is the first part of a two-part article by KENNETH W. GATLAND *outlining British contributions to the theory and practice of astronautics. The author deals first with the extensive theoretical work carried out by the B.I.S. since* 1933.

TO the casual observer, it must seem that Britain has little interest in astronautics. It is now more than two years since Russia launched the first artificial satellite into orbit, and despite the subsequent appearance of the first experimental communication and cloud survey satellites, and probe vehicles which have both hit and circled the Moon, we are still without an effective space-policy.

The best the Government has been able to contrive is a limited programme of space-research costing no more than £200,000 per year. The money is to be spent on the development of instruments which, beginning in 1961, it is hoped to place in orbit with the aid of an American rocket.

In fact, this programme is no more than a simple extension of the kind of upper atmosphere research which has been carried out with Skylark rockets at Woomera—with the difference that apparatus is now being adapted and developed for projection in a close-orbit satellite.

In view of this, it may be something of a surprise to find that British engineers have been responsible for developing much of the basic theory of astronautics. It is, in fact, 26 years since the British Interplanetary Society was formed, and 21 years since this group undertook its first serious design study.

"Cellular" Space-vehicle

This original work, which occupied the Society's Technical Committee for two years, arose from a recommendation in 1937 to consider the magnitude of the problems which would be involved in designing a vehicle to carry two or three men on a round flight to the Moon. The "Cellular Rocket," as the B.I.S. conception was called, focused attention upon the major design problems that had to be faced.

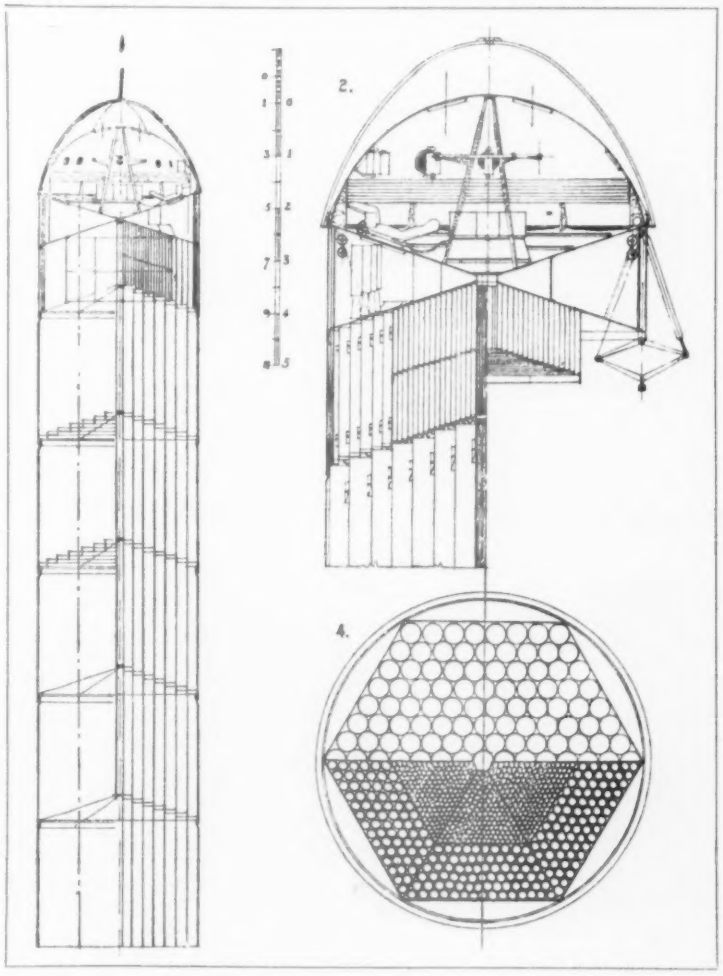
It suggested many solutions, notably in the design of the pressure cabin and instrumentation, which are still considered valuable. If our modern propulsion techniques do not entirely support the optimism expressed in 1938 for solid-propellent motors, the design at least corrected the earlier widespread belief that space-ships must be magnificent streamlined creations with large fins and rows of portholes.

The work of this pioneer B.I.S. committee obviously cannot be expected to hold much water today, in the light of contemporary experience with large rocket engines and pressurized rocket structures. It did, however, serve to emphasize one or two important aspects of astronautics which, at the time, were not widely appreciated.

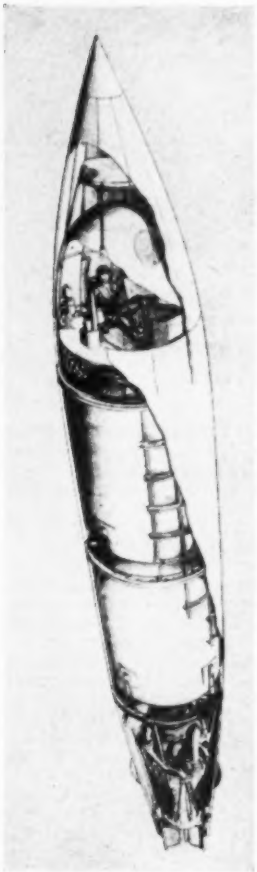
The "cellular" propulsion unit comprised approximately 2,000 solid-propellent motors, each quite self-contained and arranged in a kind of honeycomb. Firing of these motors would take place in a predetermined sequence using a rather complicated system based on the type of equipment employed in automatic telephone exchanges. This unorthodox design was one of the first attempts to solve the mass-ratio problems.

The pressure cabin was situated in the nose with clusters of solid rockets built up layer by layer beneath it, so that the spent cartridges in the first layer fell away and the next layer fired, and so on, until the vehicle reached escape velocity. Similarly, more layers of rockets were provided for use in braking against the Moon's gravitational pull and for the return flight.

Although quaint by modern standards, and clearly lacking in overall vehicle performance, the scheme effectively drew attention



The B.I.S. "cellular" space-vehicle, from the 1938 design study. On the left is the complete rocket and, on the right, the pressure cabin showing the "heat-shield" and clustered solid rockets below.



Left, the Man-Carrying Rocket was designed in 1946-47 by members of the B.I.S. Many features are similar to those being developed for the Mercury man-in-space programme.

to the problems which would have to be faced in manned space-vehicle design, and, indeed, the clustering of solid-propellent motors in the Jupiter-C and Juno II rockets is a modern application of the same basic technique.

Landing Problems

The B.I.S. pilot study was remarkable in other ways. For example, it demonstrated, for the first time, a practical method of landing a space-vehicle in an airless environment by proposing that the vehicle should land tail-first, using rocket thrust for support during descent. Landing legs were introduced to reduce the final impact at touch-down, to support the vehicle on the surface, and to prevent it from toppling over.

The use of landing legs and reverse-thrust braking would automatically set the vehicle in an upright position ready for relaunching, and the take-off from the Moon's surface could be made directly from the legs, as if from a prepared launching platform. Again, the same basic principles are embodied in the proposals outlined by Milton Rosen of the National Aeronautics and Space Administration for landing men on the Moon, using the giant Nova booster.

Another interesting feature of the "cellular" rocket was its affinity with current techniques for the re-entry of ballistic nose-cones into the atmosphere. The nose-shape proposed by the B.I.S. was not pointed, as one would have expected from contemporary experience with shells and bullets, but blunt and rounded.

Moreover, the hemispherical nose was overlaid with a "heat-resisting" carapace of a ceramic material as protection from frictional heating during its passage through the atmosphere. Whether by luck or judgment, it was a remarkable foretaste of the shape of things to come.

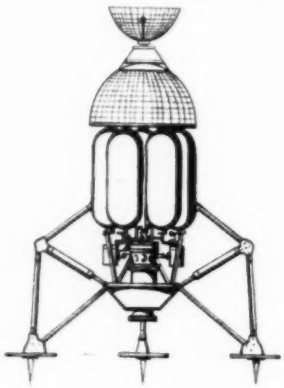
A Man-carrying V-2

At the outbreak of War in 1939, the British Interplanetary Society went into temporary suspension, re-forming again in 1945. With a whole range of German experience with advanced types of liquid and solid propellent rockets now a part of history, the B.I.S. lost no time in expressing disapproval at the way the fruits of this research were being neglected.

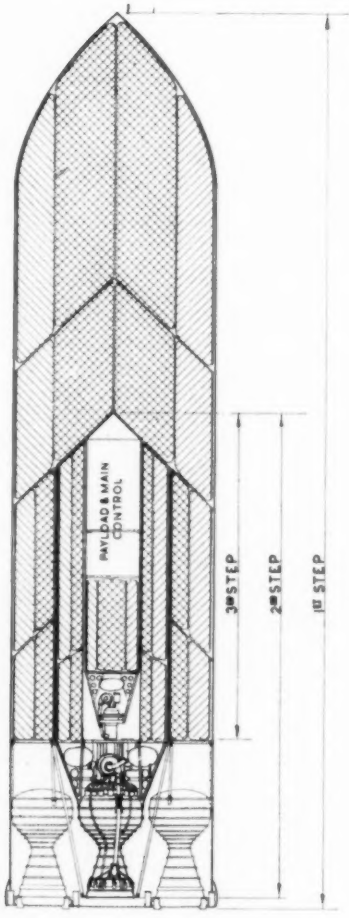
In fact, with the assistance of German personnel, the British Army had succeeded in assembling several V-2s and actually launched them from Cuxhaven at targets in the sea. Beyond that, nothing was done, while the Americans (and as it subsequently transpired, the Russians) made this German rocket the basis of their early research programmes.

In order to demonstrate the potential of the V-2 for peace-time research, two members of the B.I.S. Council, the late R. A. Smith and Mr. H. E. Ross, set about redesigning the basic V-2 to carry a human observer. By 1947, they had

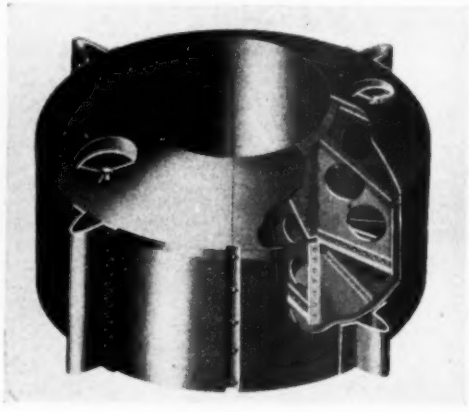
(*Continued on page 617*)



Design concept for soft-landing instruments—including a seismograph—on the surface of the Moon. From the MIGRANT pilot study, 1958.



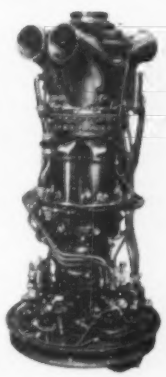
Right, 1948/49 B.I.S. design for a three-stage "expendable-tank" rocket intended to throw off empty tanks as it progressed under power. The second-stage engine was "nested" into the first-stage engine cluster and all were intended to fire together at take-off. This latter principle is employed in the Atlas ICBM.



An artist's impression of an expendable-tank section for a large rocket proposed in 1950 by a B.I.S. technical group. Built in half segments and divided by light metal diaphragms, the tanks were to be pressurized and held together with explosive ties.

WHICHEVER END THEY PUT IT

Whether it's at one end, as in the quietly efficient Westland Wessex . . . whether it's at both ends, as in the outstanding Bristol 192 . . . whether it's upright, horizontal or in any position in between, the Napier Gazelle free turbine engine will always satisfy the exacting demands of helicopter operation. Designed specifically for helicopter application, the Napier Gazelle, with its "any angle" installation, relieves the designer of many accepted limitations and gives him more opportunity to make proper use of fuselage space. The Napier Gazelle 1,650 s.h.p. free turbine was the first gas turbine engine in the world to receive M of S 150-hour Helicopter Type Approval.



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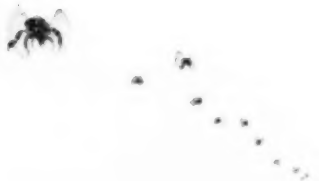

AIR BP

THE AVIATION SERVICE OF BRITISH PETROLEUM

(*Continued from page 616*)

produced a detailed design study for submission to M.o.S. The vehicle they proposed, essentially an enlarged V-2, had the warhead section replaced by a pressure cabin intended to separate from the rocket after propulsion had ceased. The purpose of the project was explained as follows:—

(1) To provide experimental data on a human being under the influence of zero-g, or "weightlessness," arising in a vehicle moving without power beyond the appreciable atmosphere.

(2) To gain experience of conditions required to maintain manual control of rockets in powered ascent under sustained acceleration.

(3) To demonstrate the practicability of returning a pressure cabin and occupant safely to the Earth from an extreme altitude.

(4) To determine the effect upon human subjects of a short period of exposure to conditions arising from lack of a surrounding atmosphere: e.g., primary cosmic radiation and ultra-violet radiation.

(5) To obtain photographs of the Earth's surface from high altitude and spectrographic records of the solar photosphere with greatly reduced interference from the Earth's atmosphere.

The 57-ft. rocket, weighing 21 tons at take-off, was intended to carry a man to an altitude of about 200 miles, beginning its flight from a near-vertical tower. It had no guide fins but would be controlled entirely by means of gyro-controlled graphite vanes impinging in the exhaust gases. Immediately after the climax of propulsion, the nose-fairing would be jettisoned and the observer would operate a control which released a compressed-air charge to drive the pressure cabin and rocket apart.

The pressure cabin, constructed of light alloy, would have two glazed observation and break-out ports, provided with shutters against the Sun's glare. It was proposed that the observer, equipped with a g-suit and a standard high-altitude flying suit, with personal parachute, oxygen, etc., would sit in a specially constructed cradle of which instruments and control boxes were integral parts. Thus, only wrist action on the part of the test observer would be necessary to monitor the flight.

Suspended on a framework above the cabin roof, on tubular supports, would be a parachute pack containing a parachute of special design providing for constant drag irrespective of the prevailing air-density or velocity of descent.

In the event of an emergency, an overriding automatic control was provided to bring about separation of the cabin and deployment of the parachute recovery system. A rigorous programme of training, it was suggested, should precede the actual firings, during which time the test observer would be gradually conditioned to acceleration effects in a centrifuge.

It is perhaps unnecessary to mention that this 13-year-old scheme bears a striking resemblance to the various sub-orbital test vehicles, such as Little Joe, now being used in the test-programme for the Mercury space-capsule—in fact, right down to the use of a cabin periscope in the proposed manned version which gives the observer his external view.

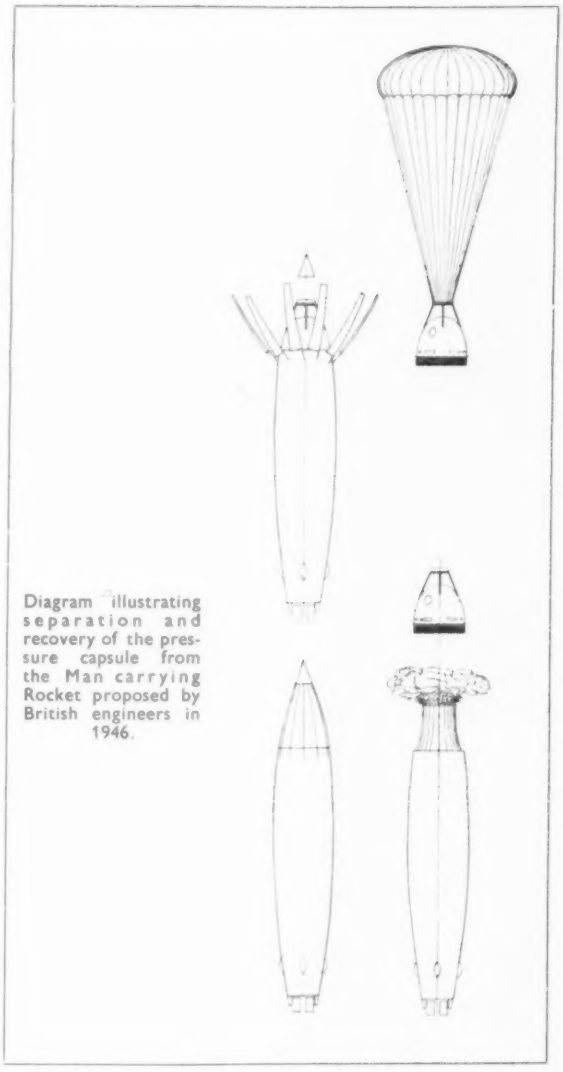

Diagram illustrating separation and recovery of the pressure capsule from the Man carrying Rocket proposed by British engineers in 1946.

Orbital Refuelling

In the following years, up to 1954, there were successively considered by B.I.S. technical groups the problem of closed systems of food and respiration for manned space-flight; the engineering requirements for a large space-station; nuclear rocket propulsion, including ion-drive; and the principle of orbital techniques.

The last named outlined the manner in which vehicle mass-ratio problems could be overcome by breaking down a given space mission into stages, using different rocket vehicles operating in a predetermined sequence—an Earth-to-orbit winged vehicle for carrying men and materials into a close-orbit; a larger space-going vehicle to transfer men to a given lunar or planetary destination, going into orbit around the target body; and a third vehicle, carried as part of the second, to effect final transfer from the orbit to the surface. A reverse sequence would operate for the return journey. All this would be effected without the use of an intermediate space station at the Earth end by refuelling the outgoing space-vehicle in orbit from supply rockets.

In 1951, in response to a recommendation by the Society's technical committee, three members of the B.I.S. undertook a design study to determine the smallest vehicle that could launch a useful scientific payload into orbit. The result was the paper "Minimum Satellite Vehicles," presented at the 2nd International Congress on Astronautics in 1951. Of four vehicles described, one was a 16-ton, three-stage rocket capable of placing in orbit at 500 miles a 6- to 8-ft.-diameter inflatable satellite. These theoretical considerations pre-dated work on the Vanguard and Explorer.

The paper also included a description of some original work on the idea of an "expendable" liquid-propellent rocket which shed its segmented tanks as propellent was consumed. Here again was an attempt to improve overall rocket performance before the advent of lightweight, pressurized tanks made other techniques unnecessary.

Since this time, the Society has published in its bi-monthly *Journal* a large number of original contributions to the science of astronautics, particularly in the field of orbit calculations and fundamental considerations of probe rockets. Last year, a pilot study was made of an unmanned probe vehicle, MIGRANT, for landing research instruments—including a seismograph—directly on the Moon's surface. The object of this study, as with so many others the Society has undertaken over the years, was to consider the next logical steps in astronautical development.

(*To be continued*)

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(1) H. E. Ross, "The B.I.S. Spaceship," British Interplanetary Society *Journal*, January, 1939.

(2) R. A. Smith and H. E. Ross, "The Man-Carrying Rocket," British Interplanetary Society *Journal*, May, 1948.

(3) K. W. Gatland, "Expendable Rockets," British Interplanetary Society *Journal*, July, 1948.

(4) K. W. Gatland, A. M. Kunesch, and A. E. Dixon, "Initial Objectives in Astronautics," British Interplanetary Society *Journal*, July, 1950.

(5) — "Britain's Part in Space Exploration," THE AEROPLANE AND ASTRONAUTICS, May 8, 1959.

DEBONAIR.—The appropriately named Beech Model 33 shows off the conventional tail which distinguishes it externally from the best-selling Bonanza.

Personal Flying

Although there is no real private flying in the Communist countries, which suffer from certain other disadvantages, all are similar in operating very strong flying club movements under benevolent Government patronage. The State provides standard training aircraft, suitably equipped with radio and other aids, and free instruction up to very advanced levels for young men and women.

Nearly all the flying clubs operate as air centres, with associated gliding and parachuting activities, and members are encouraged to take part in all these diversions, rather than to specialize. So far from this costing anything for the individual, small payments are made to encourage the sporting flying movement. In the Soviet Union, flying training is even given on helicopters, again for both men and women.

The fact that this avuncular official generosity is not entirely altruistic is indicated by the full title of DOSAAF, the governing body of Soviet sporting flying, which can be translated as "the voluntary society for supporting the Soviet army, navy and air force." And in some of the satellite countries only Communist party members are allowed to fly, in case the less-zealous citizens should be tempted to fly away.

Nevertheless, the State-aided club movement has resulted in a close-knit organization of private, airline and military flying in the Communist countries, and a great surge of airmindedness. Pilots are recruited from the flying clubs for both the civil airlines and the air forces, and there is a vigorous light aviation industry in the leading countries to supply suitable aircraft.

Nobody would like to see complete State finance, and therefore control, in our own flying clubs. But even if we cannot get more encouragement from our own Government, we would settle for a little less discouragement.

A milestone in the light aeroplane business came recently with the delivery of the 50,000th machine from the Piper Aircraft Corporation. This figure is almost certainly unrivalled by any other company, and represents large volume sales extending over nearly 30 years.

The 50,000th Piper was a twin-engined Apache for executive use, and business aviation is the major interest of the company today. For this market, it is currently producing 13 aircraft per day, and in the last financial year, increased its sales volume by 26%. In its veteran Cub, Piper has the oldest production aircraft in the World, the original design having flown for the first time in the early 'thirties.

Last year's sales turnover was well over $44 million, and the target for 1960 is more than $60¼ million. The ultimate Piper goal, set for 1965, is for $119 million, which is considered to be 45% of the World market. The new Aztec light twin entered production last month with two aircraft built; in December, 20 will be completed, with 30 in January. From then on Aztec and Apache production will account for two aircraft per day. The agricultural Piper Pawnee is being produced at the rate of one per day.

• • •

The new four-seat Beechcraft Model 33, which is virtually an "economy" Bonanza with a conventional-type tail, has been named the Debonair. Leddy Greever, Beech vice-president of commercial sales, explains that this name derives from the French "*de bonne aire*" applied way back to good hunting hawks.

It seems that the Model 33 may well live up to its name. With a 225 b.h.p. Continental fuel-injection engine, and a gross weight of 2,900 lb., it has a maximum speed of 195 m.p.h., and, moreover, it is the cheapest aircraft in the Beechcraft line.

• • •

If our readers are concerned about the amount of space devoted in these columns to American personal flying, they are no more so than we. We would be only too delighted to give detailed statistics of light aircraft production in the U.K., accounts of new types being developed, and to discuss the relative merits of the various equipment that is produced for them.

This, of course, assumes that such activities exist. At the moment, they do not. There are several gleams of hope amid the general gloom. From the West Country come rumours of activity by a well known and prominent personal flying enthusiast, and various other projects are beginning to bestir themselves.

When concrete news of these developments becomes available, we shall publish it. In the meantime we shall quote the American and Continental examples as hard as we can in the hope that their experience will be of value and a stimulus to our own enthusiasts.

Gliding Notes

by Dr. A. E. Slater

KENT Gliding Club found the escarpment alongside Lympne Airport soarable in winds between S.W. and S.S.E. during three days in October. The Club newsletter reports two cross-countries in thermals and cloud lift on September 27 in a north-easterly wind; Philippa Buckley flew the Skylark to the Southdown Club at Firle, and J. C. Bailey the Olympia to a point between Ticehurst and Wadhurst, both reaching 4,000 ft. Since the club winch achieves 3½ launches per gallon, these flights were definitely more economical in petrol than the winners of the so-called "motor-glider" competition at Lympne in 1923, who achieved about 80 miles per gallon. That is, if you don't count the retrieve by road.

• • •

NEWCASTLE GLIDING CLUB looks like establishing a permanent site in Yorkshire at the northern end of the same plateau on whose south-west corner the Yorkshire Club has been established for 25 years. Permission to set up a gliding site has been given by the local planning authority—or, to quote the red tape in full, "the North Yorkshire Moors Park Planning Committee has decided to instruct the area sub-committee to grant permission for the establishment of the gliding station."

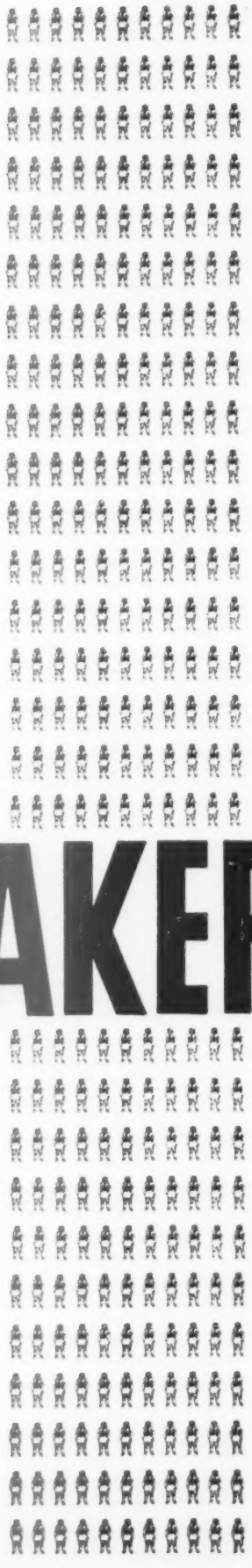
In Gliding Notes for November 27 some flights by Yorkshire Club members out-and-back along the 12-mile west face of the plateau were mentioned. From their turning-point at the north-west corner, it is 4 miles E.N.E. to the proposed new site along the north-facing escarpment, but this 4-mile stretch is cut through by a valley, causing a gap two-thirds of a mile wide.

The general run of this northerly escarpment faces N.N.W., but at Carlton Bank, where the Newcastle Club is to be established, there is a steep slope a mile long facing W.N.W. Four miles to the east is the huge bowl of Ingleby Greenhow, a favourite soaring site a quarter of a century ago.

Permission has been given to the Club to build a hangar 86 ft. by 64 ft., made of local stone with a corrugated asbestos roof, at a spot where it will not be seen from either the top or the bottom of the Cleveland Hills. They will have to build a road to it in order to provide for the last bit of the 80-mile journey from Newcastle.

The Yorkshire and Newcastle Clubs will then be only 12 miles apart, but it looks from the map as if a purely slope-soaring flight between them will not be easy in both directions on the same day. The nearest thing to this was in pre-war days when the Oxford and London Clubs were simultaneously established on the Chiltern Hills, 22 miles apart. But the gaps in the range were too wide for slope-soaring the whole way between them.

TO DATE 308 LIVES SAVED BY MARTIN-BAKER EJECTION SEATS



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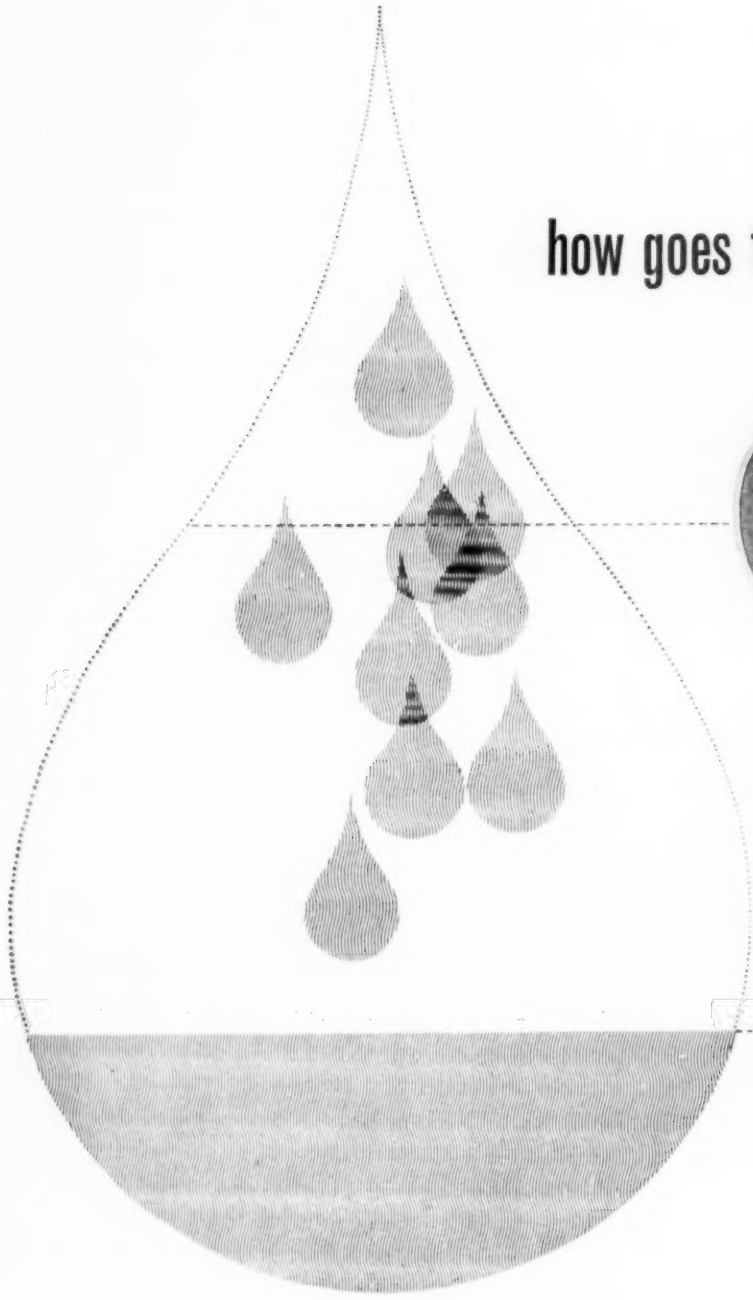

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CRC 48P

Correspondence

Collision in the Air

ALL who support the popular flying movement will welcome the contribution from Mr. Norman Jones (Nov. 20) and the prominence with which it has been presented. The outspoken views of such an experienced private pilot are invaluable in focusing attention upon one of the major problems involving popular flying today. Several controversial points are raised—doubtless with intent—and if they succeed in attracting constructive criticism and suggestions then so much the better.

But one or two of them would seem to be more likely to revive many of the bitter and useless squabbles that raged not long ago with private pilots on one side and professional pilots and air traffic controllers on the other while the Minister played the part of a silent but far-from-disinterested bystander who nevertheless came in for perhaps more than his fair share of brickbats and abuse which emerged from the scrum.

This attitude that the private pilot is the only one in step is all very well up to a point but if developed too far it will produce one of two unfortunate results: either wastage of time and effort in fruitless argument instead of collaboration and concentration upon constructive ideas and action, or the eventual elimination of popular flying altogether. What follows is offered by one who shares wholeheartedly Mr. Jones' enthusiasm but who must confess to becoming very frightened indeed whenever another aeroplane appears unexpectedly close in the air.

We must concentrate upon providing and maintaining a high standard of airmanship for all private pilots and making available a small, cheap radio installation for light aircraft so that we can then tackle the problem of allowing these aeroplanes to enjoy the maximum possible amount of freedom in the air, particularly in the unrestricted airspace which still remains. And in so doing, our hand will be immeasurably strengthened when we can prove that all private pilots are competent, and have adequate equipment, to ensure that they will incur the minimum inconvenience to others in the air. Moreover, in dealing with this matter and particularly the question of aerial safety, tolerance and co-operation are essential factors.

In particular we would do well to remember that air traffic controllers, many of whom have been pilots themselves, are usually only trying to help us all avoid breaking our necks, and whether they are motivated by conscience or fear of losing their jobs, the aim is praiseworthy to say the least. And as for airline pilots—many of whom also like flying light aeroplanes for fun—let us remember that however hard and often they may search the sky, there is precious little of it for them to see at the best of times.

Welwyn Garden City, Herts. DAVID BROWN.

Historical Facts Wanted

WOULD be very much obliged if you could give me any information on the undernoted matter.

In May, 1935, Kingsford-Smith made a jubilee flight from Australia to New Zealand.

Could you tell me where the flight commenced from, and on what date, and the aeroplane he used?

What happened that caused him to jettison most of the mail he was carrying . . . and where and on what date did he land in New Zealand?

Broxbourne, West Lothian. J. WOTHERSPOON.

Flight Assessments—Not Space Projects

HAVING just read John Fricker's excellent report on the Falco in your edition of Oct. 9, I am writing to hope that you will be able to include more articles of this nature to the exclusion, if necessary, of guided missile and rocketry articles.

Penang, Malaya. I. A. F. PURSLOW.

Curtiss Engines by the Hundred

THE discovery of a Curtiss propeller of 1914-18 vintage has led to several letters appearing in your columns, yet I venture to suggest that the possibility of finding the aircraft from which it was removed is indeed remote since there are several hundred possibilities.

Perhaps it is not realized just how many Curtiss engines were supplied. My records show 412 of the OX-5 type shipped to Britain with Curtiss H.4, J.N.3 and J.N.4 and Thomas T.2 airframes alone; doubtless others were supplied as spares. Both Curtiss and Thomas types proved unsatisfactory and their airframes were declared obsolete before their engines, which were utilized in other types, including at least 23 B.E.2cs, a number of D.H.6s and a production batch of Maurice Farman S.7 Longhorns (C.9311-9335) built by the British Electrical Engineering Co., Ltd., of Loughborough.

Not without some reason did Mr. Noel Pemberton-Billing, M.P., in reference to the question of standardization with the 61 aircraft engine types then in service, include these words in his address to the House on February 27, 1918: "We come to the Curtiss, and this country I may almost say, is littered with Curtisses. . . ."

The Curtiss-engined D.H.6s mentioned by a recent correspondent were G-EAGE, 'GF, 'HI, 'NJ, 'NU, 'WU and 'WV. Other civil types to have a Curtiss OX-5 installed were G-EAKC, a de Bolotoff De B.14 and an Avro 504K, G-EAPR.

London, S.E.4. BRUCE ROBERTSON.

Wroundsbout

Wround the World. At Lae, New Guinea, wiping away a furtive tear, I parted company with the Herald Foreign Legion—I was going to potter in an Otter, they went on their commercial way to the Far East, a friendly, efficient crew, working hard to sell their fine product.

*

Bulolo, in New Guinea, provided an idea for a sketch. A passenger who came in our DC-3 asked pilot Gus Swinbourn if he knew where a taxi might be picked up. I mentally transferred the scene to London Airport.

*

Australia: Reg Ansett really is the tiger of the Australian airline scene today. Never lets up. He's just ordered another Electra for Ansett-A.N.A.; he's changing the name of Butler Air Transport, which he owns, to "Airlines of New South Wales"—note the suggestion of ANSETT about those initials "ANSW"; and now he wants to take over the QANTAS New Guinea Services. If Reg keeps up this pressure we may see in, say, five years' time, something like this:

*

Speaking of Australian airlines, do I detect a slight deterioration in their famed standards of service? During some eighteen different services I flew on, there were three mechanical delays, of 3, 5 and 3½ hours, but worst of all, *le crime sans excuse*, an eager stewardess (*not* Qantas) started pouring black coffee before she actually arrived at my seat—my exotic tropical suit will never be the same.

*

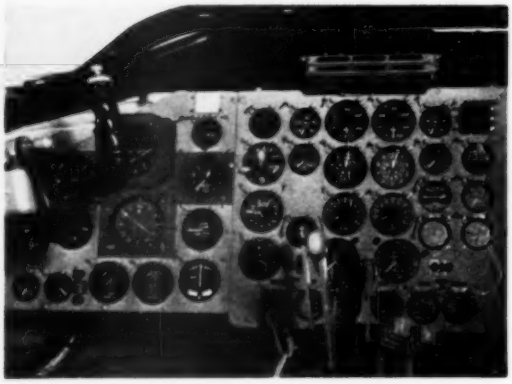
Last Leg. Here at 31,000 feet above the Atlantic the Qantas 707 is jet-streaming homewards at 627 m.p.h. Departed sweltering Sydney on time at 4.0 p.m. Wednesday which, with the International Date Line intervening, was the yesterday before yesterday. Arrive in bleak London tonight, Thursday, in a calendar time of 28½ hours—actual elapsed time will be 38 hours (27 flying, 11 on the ground). Obviously, what the airlines need is more International Date Lines.

*

Home. New Guinea-Sydney-Fiji-Hawaii-U.S.A.-London, fifteen thousand miles in about three days. It makes you think. Or, rather, it makes you shrink. Here, heaps of letters from you splendid readers, all to be answered soon. After all, sleeping is an awful waste of time.

by Lorenzo

NOTES AND EVENTS



INSTRUMENTATION.—Sperry equipment in this Handley Page Dart Herald includes an integrated system of Flight Director and autopilot. Instruments illustrated include the Sperry Zero Reader combined leading selector/control panel and the combined Zero Reader/Gyropilot indicator unit which replaces the standard pilot's control unit for the A.L. 30 Gyropilot.

MAINTENANCE.—Teams of service engineers located in London, Birmingham, Manchester and Glasgow, have been built up by Simmonds Aerocessories, Ltd., to enable the company to take full responsibility for the maintenance of airfield equipment. This development has come as a result of experience gained by the company on admiralty work.

MOLY-PAUL.—K. S. Paul, Ltd., Great Western Trading Estate, Park Royal Road, N.W.10, has published a booklet describing the various uses of Molybdenum Disulphide as a lubricant. The publication is available free from the makers.

WARERITE 1960.—Bakelite, Ltd., has introduced a new range of 16 patterns to its existing selection of Warerite laminated plastics. Providing a less formal, more abstract, type of design, the new range is known as Warerite 1960 and will be available early in the New Year.

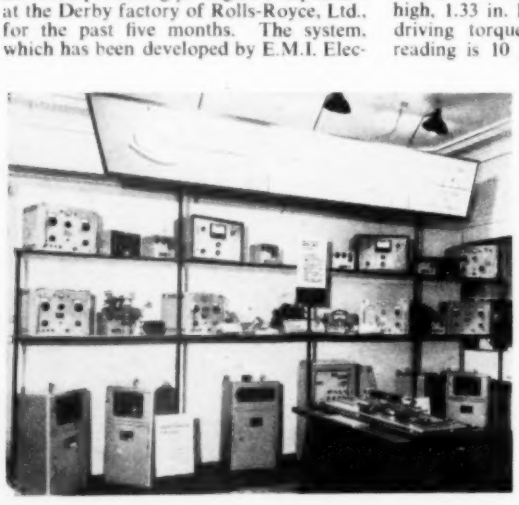
PLESSIFLEX BROCHURE. — An 18-pp. illustrated brochure describing Plessiflex seamless metallic hose is available from Power Auxiliaries, Ltd., Swindon.

FOR ACCURACY.—An electronically controlled positioning system which, when used in conjunction with conventional tools, enables high degrees of accuracy to be obtained without a skilled operator, has been producing jet engine components at the Derby factory of Rolls-Royce, Ltd., for the past five months. The system, which has been developed by E.M.I. Electronics, Ltd., in collaboration with Optical Measuring Tools, Ltd., uses a 30-in. table and records the actual position of the table and not merely the position of the worm drive or lead screw. Control is entirely by punched tape, to an accuracy of better than ± 3 sec. of arc.

AT THE BOAT SHOW.—Aircraft companies figure more prominently than ever among the exhibitors at the Sixth National Boat Show to be held at Earls Court, London, from December 30 until January 9. Amongst those represented at the Show will be Normalair, Ltd., Hawker Siddeley (Hamble), Ltd.; Bristol Aircraft, Ltd.; Folland Aircraft, Ltd.; Rotol, Ltd., and Saunders-Roe, Ltd. The latter company will be exhibiting the Hovercraft.

PROPELLER TESTING.—An A.E.I. Shrage AC commutator motor of 75 h.p. is being used to power a propeller test rig constructed by de Havilland Propellers, Ltd. The equipment is designed to simulate hydraulic operating conditions on a wide range of controllers and feathering pumps.

COUNTER.—Smiths Aviation Division has developed a 360° counter-type indicator. Possible uses for the instrument are the three-figure representation of the angular rotation of a shaft, or to indicate the heading on navigational equipment. The counter will fit into a space 1.20 in. high, 1.33 in. long and 0.81 in. wide; the driving torque required to change the reading is 10 gm./cm.



SANDERS SHOW.—Last week W. H. Sanders (Electronics), Ltd., of Stevenage held a four-day exhibition in London. Aeronautical equipment and test units on show included the company's rigid and flexible waveguide components for aircraft radar installations and micro-wave test units for aircraft and missile equipment with operating frequencies in the 3-cm. to 10-cm. bands.

Aviation Calendar

December 11. — Agricultural Aviation Group, "Aerial Operations Planning in the United Kingdom: Results and Difficulties," by Peter King, in the Library, 4 Hamilton Place, **London,** W.1, at 19.00 hrs.

December 14.—R.Ae.S. Henlow Branch, Presidential Address by R. Hills in the Assembly Hall, R.A.F. Technical College, **Henlow,** at 19.45 hrs.

December 15.—R.Ae.S. Bristol Branch Junior Committee lecture, "The Supersonic Airliner," by R. G. Thorne, at Filton House, **Bristol,** at 18.00 hrs.

December 16.—R.Ae.S. Preston Branch lecture, "The Next Generation of Civil Aircraft," by G. H. Lee, at the Queens Hotel, **Lytham,** at 19.45 hrs.

December 16. — The Institution of Mechanical Engineers, The James Clayton Lecture, "The Future of Air Breathing Engines in Aviation," by S. G. Hooker, at the Institution H.Q., 1 Birdcage Walk, Westminster, **London,** S.W.1, at 18.00 hrs.

December 16.—R.Ae.S. Coventry Branch, Film Evening at the Herbert Art Gallery, **Coventry,** at 19.30 hrs.

December 17.—Institute of the Aeronautical Sciences, Wright Brothers Lecture, at the Natural History Building Auditorium, Smithsonian Institution, **Washington D.C.,** U.S.A.

December 17.—University of London Extra-mural Studies lecture, "Soaring Weather Situation," by C. E. Wallington, at the Kronfeld Club, Basement, 74 Eccleston Square, **London,** S.W.1.

December 17.—British Institution of Radio Engineers South Western Section lecture, "The Transistor and Its Use in Communication and Control Equipment," by E. Wolfendale, at the School of Management Studies, Unity Street, **Bristol,** at 19.00 hrs.

December 17.—R.Ae.S. Lecture, "The Engineering Advantages of Rear Engines in Pure Jet Transport," by E. S. Allwright, at the Institution of Mechanical Engineers, 1 Birdcage Walk, **London,** S.W.1, at 18.00 hrs.

December 17.—R.Ae.S. Isle of Wight Annual General Meeting and Film Show, in the Clubhouse, Saunders-Roe Sports and Social Club, Church Path, **East Cowes,** at 18.00 hrs.

Company Notices

NEW COMPANY

John Webb Air Services, Ltd. (640,459).—Private co. Reg. Oct. 26. Cap. £1,000 in £1 shs. Subscribers are: Leslie A. W. Noble, 2 Doughty Street, W.C.1., Accountants; Alan Sears, 143 Carlton Avenue East, Wembley, Chartered Accountant. John S. Webb, 62 Brompton Road, S.W.3, is the first director. Sec.: L. A. W. Noble. Reg. office: 2 Doughty Street, W.C.1.

OVERSEAS COMPANY

Air Express International Agency, Ltd. (F.4835).—Particulars filed October 19. Cap.: 200 shs. without par value. Reg. in State of New York, U.S.A., on October 5, 1953. British address: Building 114, London Airport, Hounslow, Middlesex. David J. Kelsall, of 126 Bath Road, Harlington, Middlesex, is authorized to accept service of process and notices. Directors: Chester M. Mayer, Morton L. Deitch, Wickliffe Shreve, Allen Russel, Alvin B. Beck, all resident in the U.S.A. and directors of Air Express International Corporation, etc.

CHANGE OF NAME

Aeromarine of Emsworth, Ltd. (505,698). 5 Old Steine, Brighton, 1. Name changed to Emsworth Shipyard, Ltd., on July 14, 1959.

Personal Notices

BIRTHS

Curtis.—On November 30, at the Sussex Maternity Hospital, Brighton, to Anne, wife of Sqn. Ldr. Christopher Curtis, of 31 Collingham Road, S.W.5—a daughter (Emma Jane).

Mann.—On November 25, at Bicester Cottage Hospital, to Winifred (*née* O'Donnell), wife of Wg. Cdr. A. S. Mann, D.F.C., R.A.F.—a son.

Moorhouse.—On November 22, at Canadian Memorial Hospital, Taplow, Bucks, to Mollie, wife of Flt. Lt. G. H. Moorhouse—a son.

Randolph.—On November 24, at P.M.R.A.F. Hospital, Halton, to Joan (*née* Lockey), wife of Flt. Lt. P. M. Randolph, R.A.F.—a son.

Saunders.—On November 23, at Bedford General Hospital, to Margaret (*née* Foster), wife of Flt. Lt. D. A. Saunders, R.A.F.—a son.

Warren.—On November 27, at R.A.F. Hospital, Nocton Hall, to Margaret (*née* Waterson), wife of Flt. Lt. I. G. Warren, R.A.F.—a daughter (Susan Jane).

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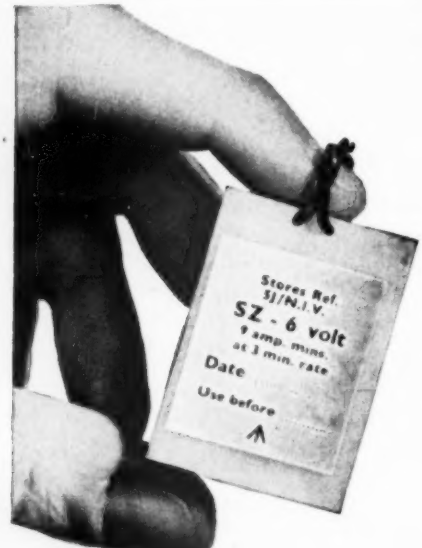

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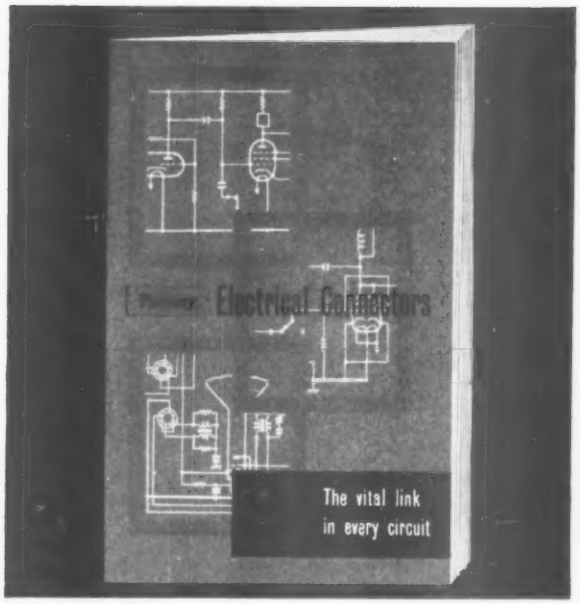

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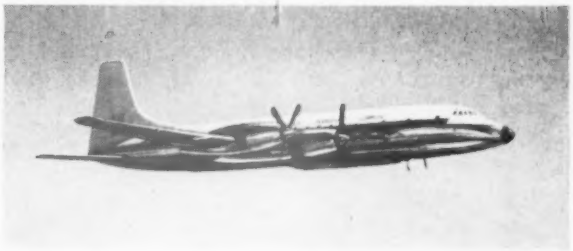

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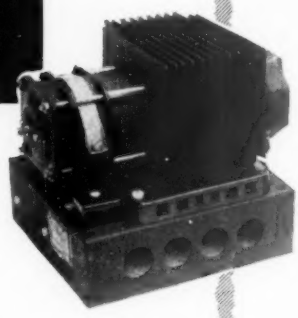
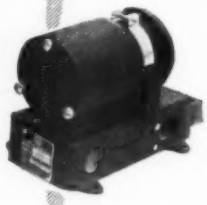


Automatic voltage regulator Type 50/51858 used in conjunction with the B.T.H. generators on the Comet 4.



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DE HAVILLAND TIGER MOTH. Ref. 2615. Gipsy Major 1 engine, A/F 4,118 hours, engine 1,308 s.c.o., dual, V.F.R., C. of A. February, 1960, £450.

DE HAVILLAND TIGER MOTH. Ref. 2594. Gipsy Major 1C engine, A/F 1,300 hours, engine 1,300 s.c.o., dual, V.F.R., C. of A. March, 1960, £375.

PERCIVAL PROCTOR III. Ref. 2716. Gipsy Queen 2 engine, airframe 1,180 hours, engine 221 hours s.c.o., propeller 44 hours s.c.o., dual blind-flying panel, C. of A. February, 1960, £485.

PERCIVAL PROCTOR V. Ref. 2601. Gipsy Queen 2 engine, airframe 710 hours, engine 152 hours, propeller 140 hours s.c.o., dual blind-flying panel, C. of A. August, 1960, £525.

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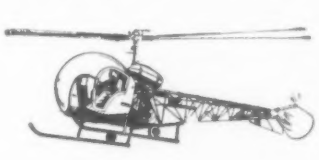

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NOTICES

AIR TRANSPORT ADVISORY COUNCIL

THE AIR TRANSPORT ADVISORY COUNCIL give notice that they have received the undermentioned applications to operate scheduled air services:—

FROM OVERSEAS AVIATION (C.I.), LTD., OF 6 YORK STREET, ST. HELIER, JERSEY, C.I.:—

APPLICATION NO. 3306 for a Normal Scheduled Service with Viking and Argonaut aircraft for the carriage of passengers, supplementary freight and mail between Liverpool and Rotterdam at an initial frequency of two return flights weekly increasing later to one return flight daily, for seven years from 1960.

FROM CLAYDON AVIATION, LTD., OF 236 OLD BEDFORD ROAD, LUTON, BEDS:—

APPLICATION NO. 3309 for a U.K. Internal Service with Viking aircraft, for the carriage of passengers, supplementary freight and mail between London Airport or London (Gatwick) and Blackpool at an initial frequency of 10 return flights weekly increasing later in accordance with traffic demand, for seven years from 1960.

FROM SILVER CITY AIRWAYS, LTD., OF 62 BROMPTON ROAD, LONDON, S.W.3:—

APPLICATION NO. 3310 for a Normal Scheduled Service for the carriage of passengers, supplementary freight and mail on the route Manston and/or Lydd and/or Bournemouth (Hurn) and/or London (Gatwick)-Lisbon-Porto Santo at a frequency with Hermes aircraft of two return flights weekly with an additional two return flights weekly on the Lisbon-Porto Santo sector, or with Dakota aircraft at twice these frequencies, for seven years from the opening date of Porto Santo Airport.

FROM DERBY AVIATION, LTD., OF DERBY AIRPORT, BURNASTON, NEAR DERBY:—

APPLICATION NO. 2083/3 for an amendment to the terms of approval of the U.K. Internal Service which they are authorized to operate on the route Derby and/or Staverton and/or Oxford-Bournemouth (Hurn) (Tech.)—Jersey, at a frequency of 3 return flights weekly with Dakota aircraft (or the equivalent capacity with Marathon aircraft) and which they have previously applied to operate to Guernsey in addition to Jersey, so as now to enable them to operate 2 additional return flights weekly from Staverton with Dakota aircraft (or the equivalent capacity with Marathon aircraft).

FROM HUNTING-CLAN AIR TRANSPORT, LTD., OF LONDON AIRPORT, HOUNSLOW, MIDDLESEX:—

APPLICATION NO. 203/8 for an amendment to the terms of approval of the All Freight Service which they are authorized to operate under Applications Nos. 203, 204 and 205, between points in the United Kingdom and points in East, Central and West Africa so as to enable them to carry from East Africa to the U.K. motor cars up to 800 kilos in weight and accompanied by one passenger at a comprehensive charge of £200. The company also seek to charge £100 each for additional car passengers (with appropriate rebates for children and infants) and 3s. per kilo for any weight in excess of 800 kilos.

FROM TRADAIR LTD. OF SOUTHEND AIRPORT, ESSEX, for the following All Freight Services with Viking aircraft, at an initial frequency of eight return flights monthly increasing later to 30 return flights monthly on each service, for seven years from date of approval:—

APPLICATION NO. 3307 on the route Southend-Lyons-Nice-Milan.

APPLICATION NO. 3308 on the route Southend-Paris-Basle or Zurich.

These applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on July 30, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and much reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the Making of representations or objections. 512-8

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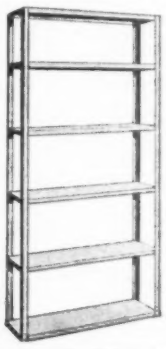

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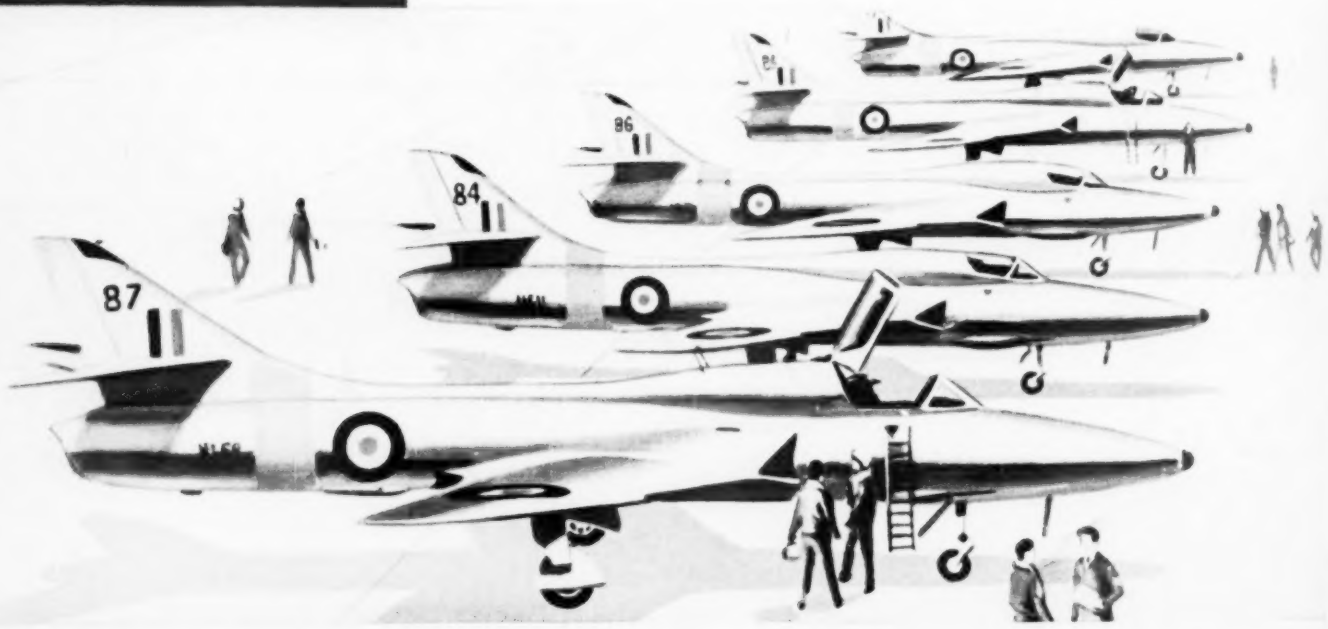

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